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GRAND (NEOSHO) DRAINAGE BASIN . A COOPERATIVE STATE-FEDERAL REPORT ON WATER POLLUTION

Public Health Service
Washington, D.C.

January 1953

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REPORT ON WATER POLLUTION

GRAND (NEOSHO) RIVER BASIN

JANUARY 1953

Prepared by

U. S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
Public Health Service

in cooperation with

Kansas State Board of Health
Oklahoma State Department of Health
The Division of Health of Missouri
Arkansas Water Pollution Control Commission

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SUMMARY

The Grand (Neosho) River Basin encompasses an area of about 12,520 square miles in four States; 6,260 square miles are in Kansas; 2,940 square miles are in Oklahoma; 2,940 square miles are in Missouri, and 380 square miles in Arkansas. The river rises in the Flint Hills of Kansas and flows southeast and south through the Tri-States Area about 480 miles to the mouth of the Arkansas River in Oklahoma.

The main stem is principally lake area in Oklahoma. The Pensacola and Fort Gibson Dams pond much of the river and the reach between the two projects will form a lake when the authorized Markham Ferry Dam is completed. The remainder of the main stem is meandering but well defined with relatively stable banks and narrow flood plains.

Climate and precipitation are moderate. Mean annual temperature is 57°F and precipitation 40 inches. The streams rising in the Ozark Mountains east of the main stem are mostly perennial due to relatively higher rainfall and flow from spring sources. Tributaries arising in the west and the main stem of the river near its source frequently have zero flow.

The total estimated population, based on the 1950 U. S. Census, was 423,000, of which 38 percent live in Kansas, 36 percent in Missouri, 21 percent in Oklahoma, and 5 percent in Arkansas.

Economic activities are widely diversified because of the variety of resources in the basin.

Water resources represent a major economic asset of the basin and are used principally for public and industrial water supplies, power generation, livestock watering, irrigation, recreation, and fish and wildlife propagation. Surface runoff is high and satisfactory water yields can be obtained for many purposes with little storage. Most ground water comes from poor aquifers of variable depth producing water of variable quality and unreliable yields.

There are 91 municipal water supplies within the basin serving 222,000 people with 23 m.g.d. Four water supplies serving 5,000 people with 0.5 m.g.d obtain water from springs. Twenty-four serving 101,000 people obtain water from surface sources, and 63 serving 116,000 people obtain water from wells. The six largest cities in the basin use about half of the total consumption from municipal systems, and the other 85 systems use the other half.

In addition, three cities located outside the basin obtain their public supplies from surface sources in the Grand River Basin. These cities use more water than the total consumed by all cities located in the basin.

Industries obtaining water from separate sources use over 64 m.g.d. No data are available on water use by oil fields in the basin, lead and zinc miles, and coal mines in Kansas. The six largest industries use over 95 percent of the total industrial water, and the remainder is used by many small industries. Most of the water used by industries is obtained from surface sources.

Favorable topographic and hydrologic features make the basin well suited for hydroelectric power development projects. Two large multi-purpose dams, Pensacola and Fort Gibson, were constructed for flood control and power production. The two combined can produce about 500 million kilowatt hours annually. A number of additional dam projects have been proposed including the large Markham Ferry project, which would impound the reach of the main stem between the two existing dams.

Stock ponds, flowing streams, and springs provide stock water. Irrigation is not practiced widely since rainfall is generally adequate and river valleys are not suited to irrigation developments.

The streams and impoundments in the basin are noted for their many recreational opportunities, especially in the Ozark Mountain area.

Commercial fishing and trapping for fur-bearing animals are practiced on a small scale.

Pollution of surface waters is not considered extensive within the basin. Wastes from municipal sources and from numerous small industries present pollution problems which are generally confined to local areas. Refineries, paper plants, oil fields, lead and zinc mines, ore concentrating mills, coal mines and a large chemical plant are major industries capable of causing serious damage to water quality but there are, at present, no known serious problems originating from these sources. These industries represent potential sources of serious pollution and continued vigilance on the part of responsible State agencies and industry is required to avoid possible major damage to water resources. Some serious local pollution problems have not yet been brought completely under control.

There are 55 municipalities with sewage collection systems serving about 192,500 people. The population equivalent of wastes contributed to municipal sewers by industries in Missouri and Kansas is about 21,500. Similar data are not available for the remainder of the basin. Treatment reduces the total pollution load by about 67 percent.

Forty-six basin municipalities with sewage collection systems have sewage treatment plants serving about 165,500 people. There are 7 primary treatment plants serving 8 communities and 39 secondary treatment works serving 38 communities. Nine municipalities, representing a total sewer connected population of 27,250, have no sewage treatment facilities.

Eighteen of the 46 sewage treatment plants are considered by State authorities to be inadequate in capacity and eleven plants are not satisfactorily operated.

In the period 1946-1952, 16 municipal sewage treatment plants or major plant improvements with a total design capacity of 263,650 were constructed. Additional municipal sewage treatment facilities needed are: new plants in nine municipalities to serve 27,250 persons, enlargements or additions in 14 municipalities to serve 57,550 persons, and replacements of existing plants in four municipalities to serve 4,300 persons. No projects are needed in 28 municipalities for 103,500 persons.

Two municipalities are actively planning projects to meet pollution abatement needs; two have plants under construction; one has had final plans approved. Eleven municipal projects needed are inactive and status of action in 11 additional communities needing new or improved waste treatment facilities is undetermined.

Data regarding sources of industrial pollution discharged directly to watercourses of the basin are relatively incomplete. There are 67 known significant sources of industrial waste pollution in the basin. Twenty-one industries provide some type of waste treatment. Forty-one discharge wastes without treatment and the facilities, if any, provided by five industries are not known. Specific information concerning type and magnitude of industrial waste loadings and efficiency of waste disposal facilities is very limited.

Pollution abatement needs for sources of industrial wastes include 34 new treatment plants, seven enlargements or additions to existing plants, two replacements of existing plants, and needs for 18 industries are undetermined. Six industries have adequate waste treatment facilities.

Information available concerning the current status of action on needed industrial wastes treatment facilities shows that 35 industries have taken no action on needs, two are actively planning, two have facilities under construction, and the status of action by 19 industries, where needs are known, is undetermined.

Water pollution control activities in Arkansas are administered by the Water Pollution Control Commission established within the State Board of Health in 1949. The existing State anti-pollution statutes and laws pertaining to financing of waste treatment plants are regarded as adequate for control of stream pollution problems in the basin. The State Fish and Game Commission is also active in the enforcement of the laws for control of pollution affecting its interests.

Water pollution control in Kansas is administered by the State Board of Health. The existing program activities are regarded as adequate, by the Board, to cope with all municipal waste pollution problems. Some divided responsibility for the control of oil field wastes exists in Kansas, particularly as applying to plugging of abandoned oil wells. The need for specific authority and financial assistance in protecting the fresh underground waters is recognized by the Board of Health.

In Missouri, the Division of Health exercises certain control over stream pollution through the broad powers delegated to the Director of the Department of Public Health and Welfare. Additional legislation has been under the jurisdiction of the Conservation Commission. Inadequate enforcement provisions of existing regulations and laws, however, have hampered the water pollution control activities in the State. Deficiencies in the present statutes are recognized and several conservation groups are actively promoting passage of needed supplemental legislation.

Water pollution control activities in Oklahoma are administered by four separate State agencies. Existing statutes do not specifically define the scope of authority and responsibility of each agency. The limitations of divided authority are recognized, and attempts are being made to coordinate activities to assure that all sources of pollution are adequately controlled and that the programs of each agency complement and aid those of the other agencies concerned.

It is estimated that the initial cost for providing needed municipal sewage treatment improvements in the Grand (Neosho) River Basin would be approximately $3,500,000 based on costs of today in this area. Considered in the estimate is the cost of providing treatment of industrial wastes discharged into municipal sewer systems in the Kansas and Missouri portion of the basin only. No reasonably accurate estimate of the cost of waste treatment facilities needed by industries discharging directly to watercourses through separate outlets can be made because available data is not adequate.

CONCLUSIONS

(1) The water resources of the Grand (Neosho) River Basin represent a major economic asset of the region and new productive water uses are being developed rapidly.

(2) The surface waters of the basin are abundant in quantity and generally of good quality. Underground water resources are usually of variable quality and unreliable in yield except in the Tri-State area where fair yields of artesian water can be obtained.

(3) The water resources of the basin are of satisfactory quality for all primary water uses and are used for a wide variety of purposes. New industries requiring large quantities of water are moving into the basin. Because of the good quality and reliable yields of surface waters, three major cities located outside the basin obtain municipal water requirements from surface sources in the basin in quantities exceeding the total municipal water use by basin communities. Increasing population and rapidly expanding industrial and agricultural development in the basin emphasize the importance of pollution control to safeguard beneficial uses of basin water resources.

(4) General pollution of basin surface waters is not extensive at present. Wastes discharged by municipalities and numerous small industries create local health hazards and nuisance conditions but ordinarily do not seriously affect downstream water uses. Major industries in the basin represent serious potential pollution problems.

(5) Eighty-three percent of the sewered municipalities, representing 86 percent of the connected population, provide some type of sewage treatment. Forty-nine percent of the existing plants are inadequate in capacity and 33 percent need improved operation.

(6) The major potential sources of damage to basin water resources are the oil fields, coal mines, lead and zinc mines and large manufacturing or processing plants.

(7) Only 29 percent of industries discharging wastes directly to watercourses provide waste treatment facilities; 64 percent discharge wastes untreated and facilities, if any, provided by seven percent of basin industrial establishments are undetermined.

(8) Deficiencies of information, particularly concerning industrial sources of pollution, indicate that additional data is essential to accurate definition of basin pollution problems.

(9) Considerable progress has been made in the period 1946-1952 toward abatement of pollution from municipal sources. A total of 14 municipal waste treatment plants or major plant improvements were constructed during the period. Available data concerning construction of

industrial waste treatment facilities is very limited.

(10) Maximum benefit can be derived from existing waste treatment plant and new facilities by expanding the activities of responsible State agencies to pr vide more frequent inspection of plant operations and more extensive plant operator training programs.

(11) Organization and authority for water pollution control activities are satisfactory in Arkansas and Kansas. Missouri needs more adequate enforcement provisions and more concentrated authority and responsibility for water pollution control would be desirable in Oklahoma. However, limited personnel and operating funds are greater obstacles to development of comprehensive pollution control programs than lack of legislative authority, particularly in Arkansas.

(12) The initial cost of providing needed municipal waste treatment facilities in the basin is estimated at $3,500,000. Data available concerning the magnitude and quality of industrial waste discharged in the basin is insufficient to permit estimation of the cost of needed industrial waste treatment facilities.

RECOMMENDATIONS

It is recommended that:

(1) Water pollution control programs be directed toward preservation of the unusually good quality of basin surface water resources by every reasonable means.

(2) Municipalities and industries assume their responsibility for abating pollution in the waters of the basin and initiate construction of needed projects.

(3) Emphasis be put on seeking a solution to the specific serious industrial wastes pollution problems. Specifically, measures should be taken to eliminate pollution of Turkey Creek in the vicinity of Joplin, Missouri.

(4) The responsible State water pollution control agencies review their pollution control laws with the objective of amending or strengthening existing statutes as needed to cope with new and specific pollution problems. Similar action be taken on statutes concerning methods of financing pollution abatement facilities to make these laws better serve their purpose.

(5) Program activities of the State water pollution control agencies be expanded to accomplish more complete surveillance over operation of waste treatment plants and make available trained and competent plant operators throughout the respective States.

(6) Public educational programs sponsored by the State health departments be expanded as a means of publicizing the extent of pollution in the basin, and informing the public of the damages resulting from pollution and benefits to be derived from pollution abatement.

(7) Continued efforts be made by responsible State water pollution control agencies to secure supplemental data, particularly on sources of industrial waste pollution, for the purpose of defining pollution problems more completely and accurately evaluating the need for corrective action. Collection of water quality data concerning basin streams should be continued in order to determine the extent of chemical pollution, indicate trends in water quality, and locate sources of pollution.

(8) Program activities of soil conservation agencies be expanded in the local areas in which sediment is a major water pollution problem.

PHYSICAL DESCRIPTION

The Grand (Neosho) River Basin comprises an area of 12,250 square miles in four States; 6,260 square miles (50 percent) in Kansas, 2,940 square miles (23.5 percent) in Oklahoma, 2,940 square miles (23.5 percent) in Missouri, and the remaining 380 square miles (3 percent) are in Arkansas.

The topography is characterized by rolling and broken uplands having rather steep slopes which provide rapid surface runoff to the tributary streams. Outcroppings of limestone, shale, and some sandstone are found in Kansas. The Flint Hills, a prominent escarpment of flint-bearing limestone, run in a north-south direction in the upper portion of the basin.

The basin is about 260 miles long and attains a width of about 80 miles in the uppermost portion which includes the watershed of the Cottonwood River. At the confluence of the Neosho and Cottonwood Rivers, near Emporia, Kansas, to St. Paul, Kansas (Mile 233), the basin narrows to a width of from 16 to 30 miles. Below that point the basin widens to include the watersheds of the Spring and Elk Rivers, reaching a maximum width of about 90 miles near the Kansas-Oklahoma State line.

The Grand (Neosho) River has its source in the Flint Hills region in Morris County, Kansas, and flows in a general southeasterly direction for a distance of approximately 315 miles in Kansas and then in a southerly direction for 165 miles in Oklahoma, a total of 480 miles. Above the mouth of the Spring River (Mile 131) the stream is known as Neosho River, and below the junction, as the Grand River.

The channel of the main stem, which is meandering and well defined, has relatively stable banks. The river and tributaries carry comparatively small amounts of silt and are considered non-navigable streams.

The central portion of the basin is characterized by numerous short tributaries. Principal tributaries entering the main stem and their respective drainage areas are as follows:

Tributary	River Mile	Drainage Area (square miles)
Cottonwood River	382.8	1,908
Flat Rock Creek	231.0	153
Lightening Creek	185.3	234
Labette Creek	171.4	397
Spring River	130.6	2,581
Elk River	113.6	1,033
Cabin Creek	67.1	505
Spavinaw Creek	60.6	401
Pryor Creek	39.7	269

The lower portion of the river in Oklahoma is virtually a continuous lake. Pensacola Reservoir (Lake of the Cherokees) with the dam located at Mile 77, extends upstream to the vicinity of Miami, Oklahoma (Mile 150). Fort Gibson Reservoir with dam at river mile 7.7 extends upstream about 39 miles to the vicinity of the proposed Markham Ferry Reservoir which will complete the series of impoundments composing the major reach of the Grand River.

Climate and Hydrologic Features

The climate of the Grand River Basin is temperate and continental, being characterized by moderate winters and long warm summers. The mean annual temperature for the basin is 57.4°F, with 76.4°F and 35.9°F as mean summer and winter temperatures respectively. Summer temperatures in the 100°F range are common.

The mean annual precipitation over the basin, based on 35 years of record, is about 40 inches. This varies from 31 inches rainfall in the headwater area to about 45 inches in the lower region. About 65 percent of the precipitation occurs from April to September. The maximum rainfall in the basin occurs along the Elk River which drains the western slope of the Ozark Mountains. Annual snowfall over the basin averages about 12 inches.

Stream flows in the Grand (Neosho) River are rather erratic. Flash flood flows are common in the upper reaches of the river in Kansas, and long periods of low flow with periods of zero flow have been recorded at Iola and Parsons, Kansas. The river system was one of the principal flood-producing tributaries of the Arkansas River. Construction of Pensacola and Fort Gibson Dams has resulted in control of flood flows in the lower reaches of the river in Oklahoma Recorded average annual stream flow, runoff per square mile, and maximum and minimum monthly discharges are shown in Table 1.

TABLE 1

GRAND (NEOSHO) RIVER BASIN

STREAM FLOW DATA

Watercourse - Gaging Station	Drainage Area (sq. mi.	Average Annual Discharge		Monthly Discharge	
		c.f.s.	c.f.s./ sq. mi.	Maximum c.f.s.	Minimum c.f.s.
Grand (Neosho) River					
Council Grove, Kansas	250	142	.57	1,420	0
Parsons, Kansas	4,817	2,440	.51	25,500	0.5
Wagoner, Oklahoma	12,307	8,740	.71	97,520	129.

ECONOMIC DEVELOPMENT

Population

The 1950 population of the Grand (Neosho) River Basin is estimated at about 423,000, of which number about 38 percent live in Kansas, 36 percent in Missouri, 21 percent in Oklahoma, and 5 percent in Arkansas. The principal communities are: in Kansas, Pittsburg-19,341, Parsons-14,750, Emporia-15,669, Chanute-10,109, and Iola-7,094; in Missouri, Joplin-38,711 Carthage-11,188, and Neosho-5,790; in Oklahoma, Miami-11,801, Vinita-5,518, Pryor-4,486, and Picher-3,951; and in Arkansas, Bentonville-2,942.

Industry and Land Use

Agriculture is well established throughout the basin. The principal crops are cereal grains and forage. The alluvial valley in Kansas is the most productive area but is subject to crop losses through floods. The area above Emporia is devoted to cattle raising, and the Ozark region to orchards, vineyards, and small fruits.

Petroleum and gas are found in the region about Chanute and Iola in Kansas and in Oklahoma.

The world's largest zinc and lead production area is located in the Tri-State area of Kansas, Oklahoma, and Missouri centered about Joplin, Missouri, and Baxter Springs, Kansas. In the area about Pittsburg, Kansas, strip coal mining operations produce large amounts of bituminous coal.

Principal industrial establishments are grain elevators, creameries, cheese plants, flour and feed mills, meat packing plants, distilleries, smelters, lead and paint works, cement plants, chemical plants, paper products plants, and petroleum refineries.

USES OF WATER RESOURCES

The principal water uses considered pertinent to water pollution control in the basin include municipal and industrial water supplies, power generation, livestock watering, irrigation, recreation, fish and wildlife, and waste disposal. Map No. 1 shows the primary water uses in the basin.

Surface runoff in streams of the basin is very high due to natural conditions and adequate water yields can be obtained with relatively little storage. Most of the ground water in the basin is obtained from shallow bedrock formations which are generally poor aquifers producing variable and unreliable yields. In the Tri-States Area of Missouri, Kansas, and Oklahoma and the Arkansas portion of the basin, deep wells under artesian pressure can provide large yields with excessive drawdown.

In general the total use of ground water does not approach the potential ground water resources of the area. In localized areas, ground water levels are declining because of local overdevelopment or improper well spacing. Wells, springs, and streams are related due to the geology of the region and excessive use of water from one of these sources may affect the other sources.

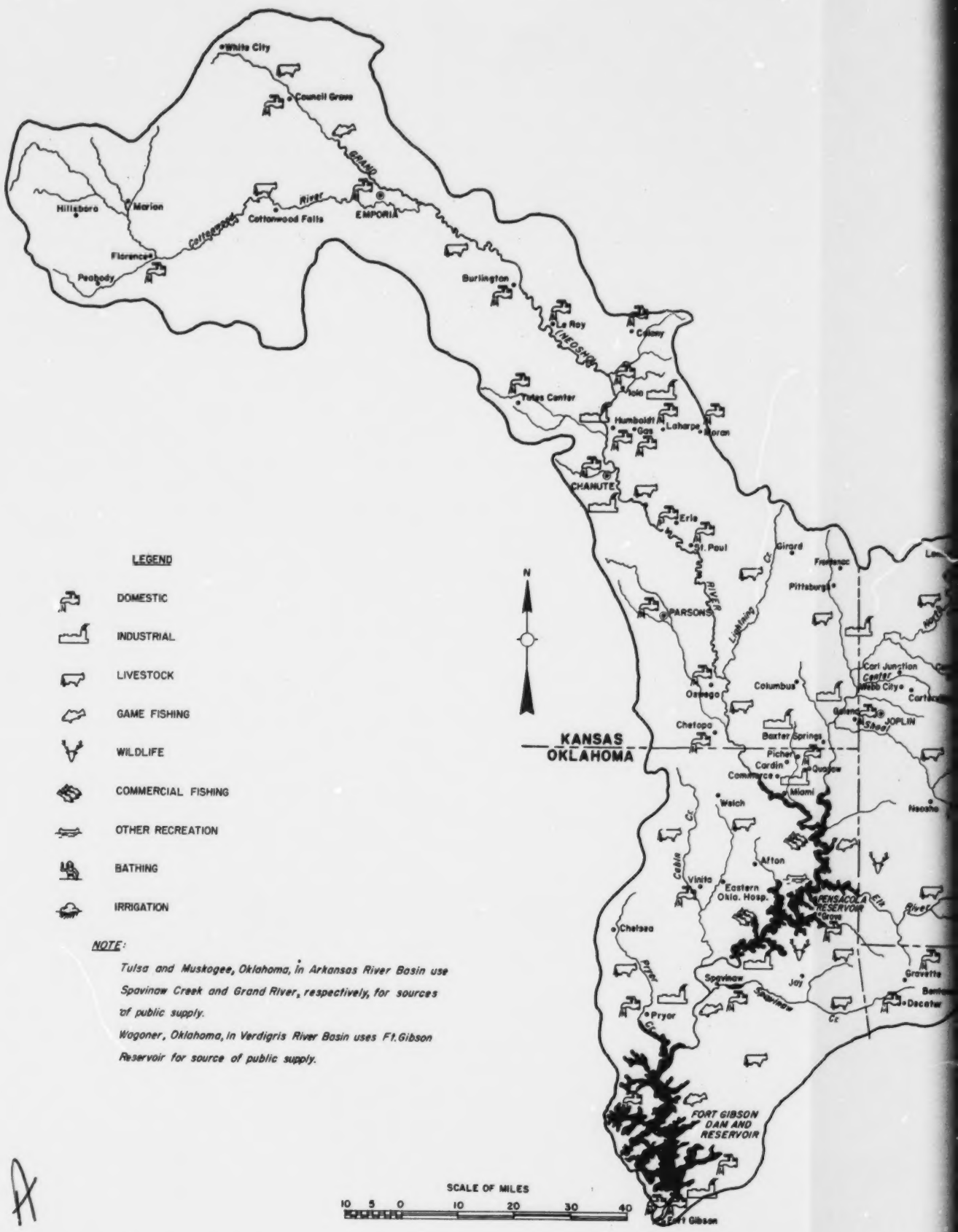
Quality of most surface waters is very good. Many ground water supplies contain excessive amounts of hardness because of their passage through limestone and dolomite formations; others contain undesirable amounts of iron and manganese.

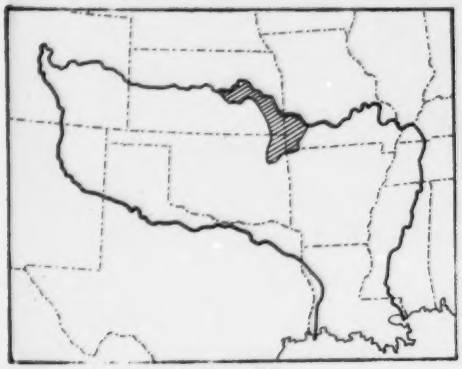
Municipal Water Supplies

Table 2 is a summary of the municipal water supplies in the basin obtained from surface and ground water sources. The table includes all municipally and privately owned supplies which provide community-wide service. For the purpose of this table, sources obtained from springs were classified as surface supplies.

There are 91 municipal water supplies in the basin serving approximately 222,300 people with an average of 22.6 m.g.d. There are four water supplies, serving approximately 5,300 people with an average of 0.6 m.g.d., which obtain water from springs. Twenty-four water supplies, serving approximately 100,800 people with an average of 12.8 m.g.d., obtain water from surface sources other than springs. Sixty-three water supply systems, serving approximately 116,200 people with an average of 9.3 m.g.d., obtain water from underground sources.

Average per capita consumption of water by towns located in the basin is 102 gallons per day with 126 g.p.c.d. used by surface supplies and 80 g.p.c.d. by well supplies. The bulk of the water used is in towns with populations less than 10,000. Five cities in the basin have populations between 10,000-20,000.


White City
Council Grove
GRAND
Hillsboro
Marion
Cottonwood River
Cottonwood Falls
EMPORIA
Florence
Peabody
Burlington
LaRoy
Colony
NEOSHO
Iola
Tulsa Center
Humboldt
Gas
Lahrpe
Moran
CHANUTE
Erie
St. Paul
Girard
Fredonia
Pittsburg
PARSONS
Lightning
Cr.
Cori Junction
Center
Webb City
Carterville
Columbus
Oswego
Galena
JOPLIN
Chetopa
Baxter Springs
KANSAS
OKLAHOMA
Picher
Cardin
Quapaw
Commerce
Miami
Welch
Neosho
Cabin Cr.
Afton
Vinita
Eastern
Okla. Hosp.
PENSACOLA
RESERVOIR
Grove
Elk
River
Chelsea
Spavinaw
Joy
Gravette
Bentonville
Decatur
Pryor
Cr.
FORT GIBSON
DAM AND
RESERVOIR
Ft Gibson
N
LEGEND
DOMESTIC
INDUSTRIAL
LIVESTOCK
GAME FISHING
WILDLIFE
COMMERCIAL FISHING
OTHER RECREATION
BATHING
IRRIGATION
NOTE:
Tulsa and Muskogee, Oklahoma, in Arkansas River Basin use Spavinaw Creek and Grand River, respectively, for sources of public supply.
Wagoner, Oklahoma, in Verdigris River Basin uses Ft. Gibson Reservoir for source of public supply.
SCALE OF MILES
10 5 0 10 20 30 40



VICINITY MAP
SCALE OF MILES
100 0 100 200 300

GRAND (NEOSHO) RIVER BASIN

EXISTING PRIMARY WATER USES

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
Public Health Service
Division of Water Pollution Control
MAP NO. 1

13 B

TABLE 2

Sheet 1 of 5

GRAND (NEOSHO) RIVER BASIN

MUNICIPAL WATER SUPPLIES

Municipality	Population Served (1950)	Average Output m.g.d.	Average Consumption g.p.c.d.	Source of Supply	Type of Treatment*
			From Surface Sources		
ARKANSAS					
Bentonville	3,200	0.450	140	Springs	P
Decatur	400	.020	50	Springs	D
Sulphur Springs	800	.060	75	Spring	D
KANSAS					
Burlington	1,800	.150	83	Neosho River	P
Chanute	9,300	.800	80	Neosho River	PH
Chetopa	1,350	.050	37	Neosho River	P
Colony	280	.010	36	Deer Creek (impoundment)	P
Council Grove	2,200	.500	227	Lake (Neosho R. Emerg.)	P
Emporia	12,000	2.000	167	Neosho River (impoundment)	PH
Erie	1,100	.210	190	Neosho River & shallow well	PH
Florence	930	.050	54	Spring	D
Gas (city)	200	See Iola	See Iola	See Iola	See Iola
Humboldt	1,950	.250	128	Neosho River	P
Iola	6,000	.700	108	Neosho River	PH
LaHarpe	300	See Iola	See Iola	See Iola	See Iola
LeRoy	450	.040	89	Neosho River	P
Moran	500	.030	60	Imp. Reservoir	P
Oswego	2,000	.200	100	Neosho River	P
Parsons	13,000	2.500	192	Labette Creek (Neosho Aux.)	P
St. Paul	450	.030	67	Neosho River	P
Yates Center	1,500	.060	40	Imp. Reservoir	P
MISSOURI					
Joplin	34,000	3.250	96	Shoal Creek	P
Lamar	2,700	.250	93	Muddy Creek	P

TABLE 2 Cont'd

GRAND (NEOSHO) RIVER BASIN

MUNICIPAL WATER SUPPLIES

Municipality	Population Served (1950)	Average Output m.g.d.	Average Consumption g.p.c.d.	Source of Supply	Type of Treatment*
OKLAHOMA					
Fort Gibson	1,230	.050	41	Grand River	D
Grove	1,090	.055	50E	Grand Lake	P
Pryor	2,500	1.000	400	Grand River	P
Spavinaw	225	.025	112	Lake Spavinaw	D
Vinita	5,185	.600	116	Grand Lake	P
Muskogee*	32,330	5.60	173	Grand River	P
Tulsa*	147,000	20.0	136	Lake Spavinaw	P
Wagoner*	3,535	0.50	141	Grand River	P
Totals exclusive of Muskogee, Tulsa, and Wagoner	106,140	13.340	126		
Totals - Muskogee, Tulsa, and Wagoner	182,865	26.100	143		
			(From Ground Sources)		
ARKANSAS					
Gravette	1,100	.040	36	Well	None
KANSAS					
Arma	1,200	.040	33	Deep wells	I
Baxter Springs	4,800	.350	73	Deep wells	I
Burns	190	.010	53	Deep wells	D
Cherokee	1,000	.080	80	Deep wells	I
Columbus	3,000	.350	117	Deep wells	I
Cottonwood Falls	1,000	.080	80	Shallow wells	AD
Frontenac	1,700	.130	77	Deep wells	ASD

*Cities located outside the basin using sources of supply within the basin

TABLE 2 Cont'd

GRAND (NEOSHO) RIVER BASIN

MUNICIPAL WATER SUPPLIES

Municipality	Population Served (1950)	Average Output m.g.d.	Average Consumption g.p.c.d.	Source of Supply	Type of Treatment*
KANSAS (cont'd)					
Galena	3,400	.400	117	Deep well	None
Girard	2,500	.300	120	Deep wells	I
Hartford	300	.010	33	Shallow wells	D
Hillsboro	1,200	.200	167	Shallow wells	D
McCune	300	.050	167	Deep wells	ASD
Peabody	1,100	.070	64	Shallow wells	D
Pittsburg	18,500	2.000	108	Deep wells	H
Scammon	600	.030	50	Deep well	D
Strong	800	.050	62	Shallow well	HI
Treece	400	.020	50	Deep well	None
Weir	1,000	.080	80	Deep wells	D
West Mineral	300	.040	133	Deep well	D
White City	450	.020	44	Deep well	None
MISSOURI					
Alba	280	.100	360	Drilled well	None
Anderson	900	.020	22	Drilled well	None
Aurora	3,900	.300	77	Drilled well	None
Carl Junction	900	.075	83	Drilled well	None
Carterville	(1,600)X			See Webb City	See Webb City
Carthage	10,500	.600	57	Drilled wells	IH
Duenweg	400	.027	67	Drilled well	None
Golden City	450	.014	31	Drilled well	None
Goodman	160	.005	31	Drilled well	None
Granby	1,100	.040	36	Drilled well	None
Jasper	500	.025	50	Drilled well	None
Lanagan	50	.001	20	Drilled well	None
Marionville	1,000	.050	50	Drilled well	D

TABLE 2 Cont'd

GRAND (NEOSHO) RIVER BASIN

MUNICIPAL WATER SUPPLIES

Municipality	Population Served (1950)	Average Output m.g.d.	Average Consumption g.p.c.d.	Source of Supply	Type of Treatment*
MISSOURI (cont'd)					
Miller	310	.020	65	Drilled well	None
Monett	4,200	.350	83	Drilled wells	D
Mt. Vernon	1,600	.225	140	Drilled wells	None
Mt. Vernon State Sanitarium	1,050	.105	100E	Drilled wells	None
Neck City	(358)	See Purcell	See Purcell	See Purcell	See Purcell
Neosho	10,000	1.008	100	Drilled wells	AD
Noel	450	.025	55	Drilled wells	None
Oronogo	480	.040	83	Drilled well	None
Peirce City	600	.090	150	Drilled well	None
Pineville	500	.035	70	Drilled well	None
Purcell	500	.043E	50E	Drilled well	None
Sarcoxie	1,400	.035	25	Drilled well	None
Seneca	1,000	.050	50	Drilled well	None
Southwest City	210	.010	48	Drilled well	None
Steele	650	.075	115	Drilled wells	P
Verona	(400)	(.025)	62	See Aurora	See Aurora
Webb City	6,700	.215	32	Drilled wells	AD
Wheaton	350	.010	31	Drilled well	None
OKLAHOMA					
Afton	1,260	.063E	50E	Wells	A
Cardin	435	.022E	50E	Well	None
Commerce	2,300	.138E	60E	Wells	None
Fairland	600	.030E	50E	Well	None
Jay	700	.035E	50E	Well	None
Locust Grove	350	.035	100	Spring	D

TABLE 2 Cont'd

GRAND (NEOSHO) RIVER BASIN

MUNICIPAL WATER SUPPLIES

Municipality	Population Served (1950)	Average Output m.g.d.	Average Consumption g.p.c.d.	Source of Supply	Type of Treatment*
OKLAHOMA (cont'd)					
Miami	8,345	.520	62	Wells	None
Picher	5,300	.400	75	Wells	None
Quapaw	800	.040E	50E	Well	None
Salina	690	.040	58	Well	D
Welch	450	.023E	50E	Well	None
All Sources	116,210	9.289	80		
Totals Exclusive of Muskogee, Tulsa, Wagoner	222,350	22.629	102		
Totals Including Muskogee, Tulsa, Wagoner	405,215	48.729	120		

X - Estimated population served based on census.
E - Water use estimated from per capita consumption of similar cities.

Treatment Code
P - Purification (Coagulation, settling, filtration, disinfection)
I - Iron or Manganese Removal and disinfection
H - Softening
A - Aeration only
S - Sedimentation only
D - Disinfection only

Joplin, Missouri, has a population of 39,000. The other 85 cities in the basin with public water supplies have less than 10,000 population.

Almost half of the population served by public water supplies use water obtained from surface sources, and this group consumes almost 60% of the water used by public water supplies of the basin. With expanding agricultural and industrial activities and growth of urban areas, greater demands for water will be met from surface water resources.

In addition to the public supplies summarized above, three cities located outside the basin obtain their water supplies from surface sources within the basin. Tulsa, Muskogee, and Wagoner serve a total of 182,865 people with 26.1 m.g. of water per day obtained from impoundments in the basin because supplies in the Grand (Neosho) River Basin are more reliable and of superior quality to available sources closer to those cities.

Industrial Water Supplies

Fairly detailed information on industrial water use has been obtained by States in the basin from individual industries. Most of the industries included in this tabulation are small scale enterprises which use public water supplies. Only those using over 20,000 g.p.d. are included in summaries contained herein. Use of industries served by public supplies are included in Table 2. Total water use by industries with separate supplies is 51 m.g.d. This includes one industry using 40.3 m.g.d. The five largest industrial water users require 95% of the total used by industries with separate supplies. In addition to uses already stated, coal mining operations in Oklahoma use about 13 m.g.d. Information is lacking on the water used in oil production, most lead and zinc mining and smelting operations, and coal production in Kansas. Most of the industrial water is obtained from surface sources.

Industries using water in the Arkansas portion of the basin consist mostly of small poultry dressing, meat packing, and canning plants. These plants process products from the orchards, vineyards, poultry, and livestock farms which represent the major agricultural ventures in the region.

Industrial water users in the Kansas portion of the basin represent the following variety of activities: chemicals production, petroleum production and refining, cement manufacture, lead and zinc mining and smelting, coal mining, clay products manufacture, milk processing, distilling, meat packing, canning, quarrying, grain storage, and flour and feed milling. Total industrial water use in the Kansas portion of the basin is about 45 m.g.d. of which over 40 m.g.d. is used by a single chemical industry.

Industries in the Missouri portion of the basin consist of milk processing, meat packing, poultry dressing, chemicals manufacturing and distilling plants. Most plants are small. The aggregate water use of all plants using more than 20,000 g.p.d. is about 0.75 m.g.d.

Industries using water in the Oklahoma portion of the basin are food processing plants, paper products manufacturing plants, lead and zinc mines and smelters, petroleum and gas plants, and coal mining operations. Total water consumption by all industries in the Oklahoma portion of the basin is about 5 m.g.d.

Power Generation

The Grand River and its tributaries are particularly well suited for the development of hydroelectric power projects because of favorable topographic and hydrologic factors and because power development can be combined with flood control to form multiple purpose projects. The Pensacola Dam was constructed by Grand River Dam Authority, a corporation owned by the State of Oklahoma. The dam impounds the "Lake O' the Cherokees" and is a multiple purpose project which will produce over 300 million kilowatts annually when all generators are installed. The Fort Gibson Dam, located near the mouth of the Grand River and constructed by the Corps of Engineers, will produce over 180 million kilowatt hours annually. Markham Ferry Dam, authorized and approved by Congress, but not yet under construction, will produce over 158 million kilowatt hours annually. Markham Ferry Dam will be located at the head of the lake formed by Fort Gibson Dam and its lake will extend to Pensacola Dam.

Four smaller dam projects in the headwaters of the basin in Kansas have been approved but are not yet under construction.

Agricultural Use

Much of the open land in the Grand (Neosho) River Basin is used for raising livestock. The livestock industry is directly dependent on water supply. Many small streams have been dammed for stock water ponds, and flowing streams and springs are important sources of stock water. Irrigation is not practiced widely since rainfall is generally adequate and the character of the land in the valley along most of the river is not particularly adapted to irrigation. Most of the irrigated areas are local developments where wells are used or water is pumped directly from the stream to adjoining lands.

Recreation, Fish and Wildlife

The Grand (Neosho) River Basin is on the eastern edge of an area which is literally "lake starved," and the lakes and streams in the basin have been heavily developed for such recreational uses as fishing, boating, and other water sports.

In Mayes County, Oklahoma, over 11,000 resident fishing licenses were sold, and in Delaware County over 4,000 ten-day trip licenses were sold in 1949. No figures or estimates are available on the amount of money spent

on recreation in the basin in connection with water sports, but the amount is considered appreciable because of the intensive use of these facilities.

The lake areas in the drainage basin are being used intensively for recreation in the form of hunting, fishing, and camping. Park and picnic areas are located adjacent to these lakes for the convenience of persons seeking recreation.

If and when Markham Ferry Dam, which has been authorized and approved by Congress, is constructed the Grand (Neosho) River in Oklahoma will be a series of lakes from its mouth at the Arkansas River to the Kansas State Line, which is over 150 river miles. In addition to these lakes, the City of Tulsa has an impoundment on Spavinaw Creek near the town of Spavinaw and proposes to build another dam upstream from Lake Spavinaw to supplement the yield available from Lake Spavinaw. This reach of the river should develop into a great recreation area attracting patronage from the large cities of Oklahoma and neighboring States.

Commercial fishing is done on a small scale on the Grand River. Wildlife in the basin, besides furnishing recreation, forms a minor source of food supply, and the trapping of mink, muskrat, and other fur-bearing animals along the streams and lakes is an important source of supplemental income for the people living along the streams. No figures on the commercial value of these resources are available.

Waste Disposal

The streams in the basin are used for the final disposal of municipal and industrial wastes. Adequate control must be exercised to see that the use of streams for the disposal of wastes does not adversely affect the primary water uses. All water uses will benefit from pollution abatement which must be accomplished by judicious use of watercourses for final disposal of sewage and industrial wastes which have been adequately treated to prevent damage to the receiving watercourse.

POLLUTION CONTRIBUTED TO WATER RESOURCES

Pollution contributed to water resources of the basin may be listed under the following three general categories:

(1) Municipal pollution - sewage and other wastes discharged with or without treatment from public and institutional sewage collection systems.

(2) Industrial pollution - industrial process wastes which are discharged directly to watercourses through separate outlets.

(3) Natural pollution - sediment resulting from erosion of lands and minerals dissolved in waters by contact with natural soluble mineral deposits.

Tables A and B herein, summarize the available information on the extent of pollution originating from municipal and industrial sources which is discharged to the watercourses of the Grand (Neosho) River Basin. Maps No. 2 and 3, showing the locations of sources of municipal and known industrial pollution, present a pictorial summary of the data on the extent of pollution discharged to the waters of the basin.

Table 3 shows the mean and maximum suspended sediment concentration by weight for a number of stations on the main stem and tributaries.

There are 55 municipalities with populations ranging from 483 to 38,711 having sewage collection systems, which are considered as sources of pollution. A total population of about 192,500 is connected to sewers. Data available for Missouri and Kansas shows that industrial plants discharge organic wastes to municipal sewers equal to a population of about 21,500. The types of industries discharging these wastes include canning, poultry dressing, slaughtering and meat packing, and milk processing. It is reasonable to assume that additional organic industrial wastes are discharged to sewers in the remainder of the basin.

The total amount of pollution discharged to the watercourses of the basin from municipal sources is equivalent to the untreated wastes of nearly 65,000 people (population equivalent).

In Arkansas, two municipalities with populations of 2,942 and 894 have sewage collection systems. Both have sewage treatment facilities. Approximately 3,650 people are provided with sewer service. Pollution load is reduced by 85% prior to discharge into streams.

In Kansas, 27 municipalities with populations ranging from 540 to 19,341 have sewage collection systems serving a total of 98,500 people. In addition industries discharge to municipal sewers a population equivalent of 14,550.

TABLE A

SOURCES OF POLLUTION

MUNICIPAL

Municipalities*	Sources of Pollution (In Number of Municipalities*)	Population Served by Sewerage System	Amount of Pollution Discharged to Watercourse (In Terms of Equivalent Number of People)
Having data on pollution load discharged to watercourse	Arkansas 2 Kansas 27 Missouri 14 Oklahoma 12	Arkansas 3,650 Kansas 98,500 Missouri 60,965 Oklahoma 29,400	Arkansas 560 Kansas 43,905 Missouri 12,860 Oklahoma 7,010
Having population data available (Data on pollution load to watercourse incomplete or not available)	--	--	--
TOTAL	55	192,515	64,335

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers or other population centers; sanitary sewage wastes, discharged by industry directly into watercourse and industrial wastes discharged into municipal sewage systems.

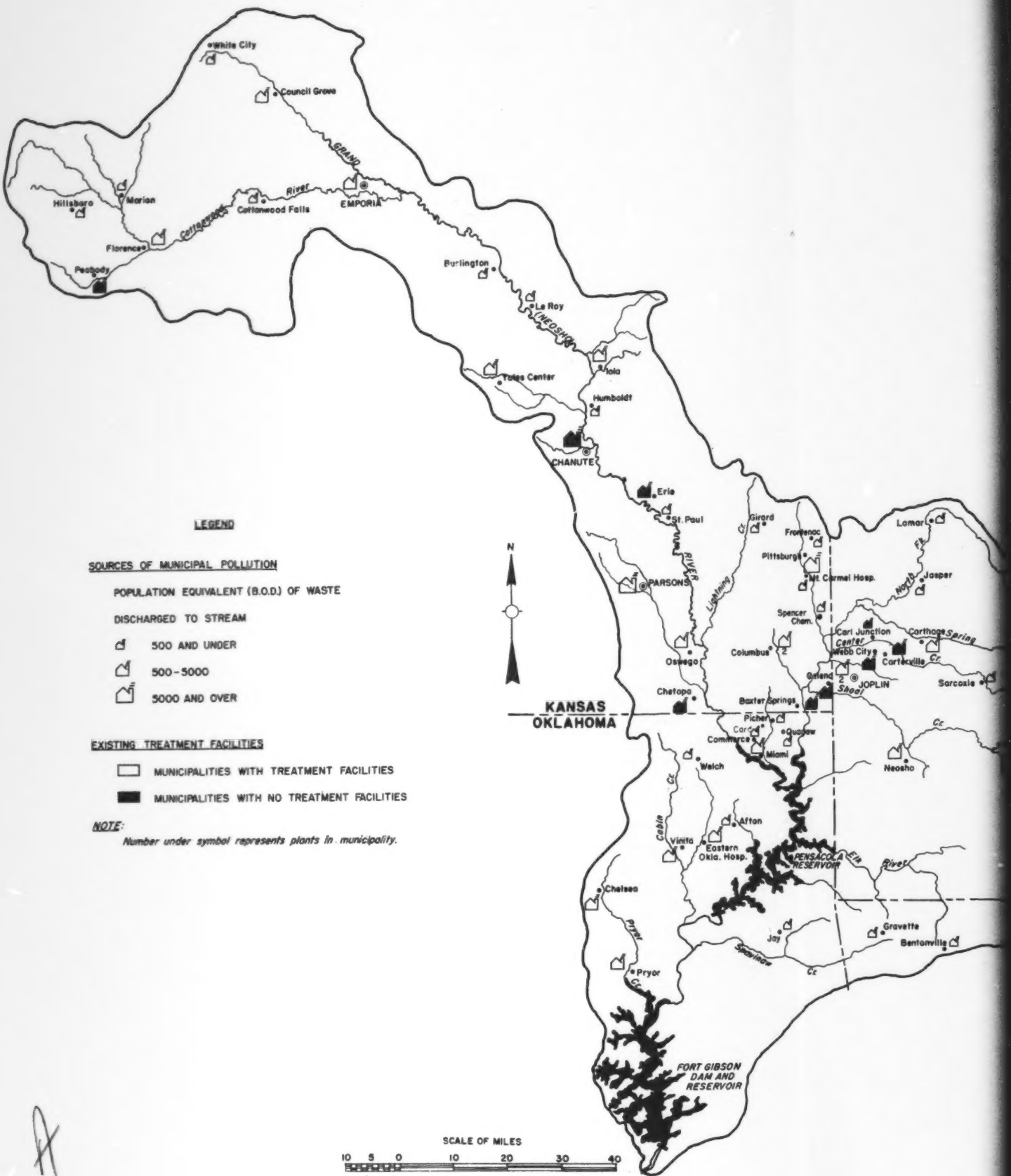
TABLE B

SOURCES OF POLLUTION

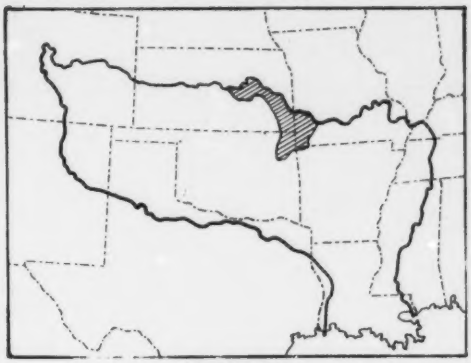
INDUSTRIAL*

Industries*	Sources of Pollution (In Number of Plants)	Amount of Pollution Discharged to Watercourse (In Terms of Equivalent Number of People)
Producing Organic Wastes	Ark. 9 Mo. 22 a/ Kans. 14 Okla. 2	Ark. 6,800 Mo. 41,700 Kans. 34,500 Okla. 1,000
Producing Organic Wastes	Ark. 5 Mo. 1 Kans. 6 b/ Okla. 2	Undetermined
Producing Inorganic Wastes	Ark. 0 Mo. 1 a/ Kans. 5 b/ Okla. 3	xxx
Producing Wastes of Undetermined Type	0	---
TOTAL	67	xxx

*Industries having separate outlets discharging to watercourses.
a/Includes one industry producing both organic and inorganic wastes.
b/Includes two industries producing both organic and inorganic wastes.


White City
Council Grove
GRAND
River
Hillsboro
Marion
Cottonwood Falls
EMPORIA
Cottonwood
Florence
Peabody
Burlington
La Roy
NEOSHO
Iola
Yates Center
Humboldt
CHANUTE
Erie
St. Paul
Girard
Cr.
Fronenoc
Lamar
Pittsburg
Mt. Carmel Hosp.
North Fk.
Jasper
PARSONS
Lightning
Creek
Spencer Chem.
Carl Junction
Center
Webb City
Carthage
Spring
Columbus
Oswego
Carterville
Cr.
Sarcoxie
Galena
JOPLIN
Shoal
Chetopa
Baxter Springs
KANSAS
OKLAHOMA
Picher
Cardin
Quapaw
Commerce
Miami
Welch
Neosho
Cr.
Cabin
Cr.
Afton
Vinita
Eastern
Okla. Hosp.
PENSACOLA
RESERVOIR
Elk
River
Chelsea
Pryor
Cr.
Jay
Gravette
Bentonville
Spavinaw
Cr.
FORT GIBSON
DAM AND
RESERVOIR
N
LEGEND
SOURCES OF MUNICIPAL POLLUTION
POPULATION EQUIVALENT (B.O.D.) OF WASTE
DISCHARGED TO STREAM
500 AND UNDER
500 - 5000
5000 AND OVER
EXISTING TREATMENT FACILITIES
MUNICIPALITIES WITH TREATMENT FACILITIES
MUNICIPALITIES WITH NO TREATMENT FACILITIES
NOTE:
Number under symbol represents plants in municipality.
SCALE OF MILES
10 5 0 10 20 30 40

-24



GRAND (NEOSHO) RIVER BASIN

SOURCES OF MUNICIPAL POLLUTION AND EXISTING TREATMENT FACILITIES

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
Public Health Service
Division of Water Pollution Control
MAP NO. 2

B

LEGEND

SOURCE OF POLLUTION

INDUSTRIAL

OTHER INDUSTRY

OILFIELD

EXISTING TREATMENT FACILITIES

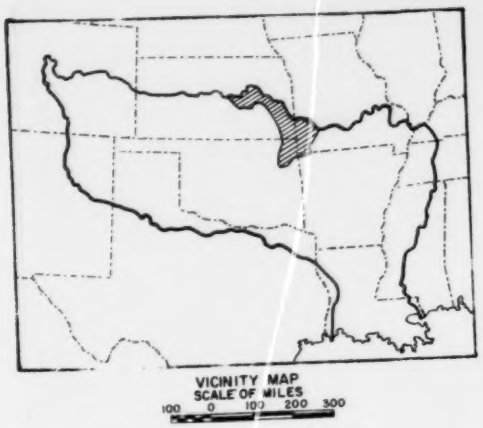
SOURCES WITH TREATMENT FACILITIES

SOURCES WITH NO TREATMENT FACILITIES

SOURCES WITH TREATMENT FACILITIES UNDETERMINED

NOTE- (1) Numbers below symbol indicates total number of known oilfields in the county area in the category designated

(2) Numbers with symbol indicates total number of known plants in the area



GRAND (NEOSHO) RIVER BASIN

SOURCES OF INDUSTRIAL POLLUTION AND EXISTING TREATMENT FACILITIES

B

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
Public Health Service
Division of Water Pollution Control
MAP NO. 3

25-

TABLE 3

MEAN AND MAXIMUM SUSPENDED SEDIMENT CONCENTRATION

GRAND (NEOSHO) RIVER AND TRIBUTARIES

Watercourse - Gaging Station	Drainage Area (sq.mi.)	Mean Sediment Concentration By Weight (p.p.m.)	Maximum Sediment Concentration By Weight (p.p.m.)
GRAND (NEOSHO) RIVER			
Council Grove, Kansas	265	3,300	10,400
Strawn, Kansas	2,933	2,600	7,200
Iola, Kansas	3,818	1,200	3,500
Commerce, Oklahoma	5,876	1,100	3,000
Choteau, Oklahoma	11,546	300	1,900
Cottonwood River			
Marion, Kansas	335	2,000	7,100
Cedar Creek			
Cedar Point, Kansas	110	1,500	6,200
Middle Creek			
Elmdale, Kansas	84	2,000	6,100
Flat Rock Creek			
St. Paul, Kansas		1,200	1,900
Lightning Creek			
McCune, Kansas	197	1,000	6,300
Labette Creek			
Oswego, Kansas	209	1,100	4,100
Spring Creek			
Quapaw, Oklahoma	2,510	400	2,100
Elk River			
Tiff City, Missouri	872	600	3,900

Twenty-one communities provide some type of treatment. Pollution load is reduced by 55 percent prior to discharge to streams. Pollution in varying degrees occur below Peabody, Florence, Marion, Cottonwood Falls, Council Grove, Iola, (city and milk plant)Erie, Parsons, Oswego, Chetopa, Baxter Springs, and Galena (city and distillery) and possibly other communities. Some of these problems are in the process of correction. Local groups throughout the basin are requesting action and were threatening damage suits in at least two areas at the end of the year.

In Missouri, 14 municipalities with populations ranging from 776 to 38,711 have sewage collection systems serving a total of about 61,000 people. In addition industries discharge to sewers a population equivalent of 7,000. Eleven of the municipalities have some type of treatment. Pollution load is reduced by 79 percent before discharge to streams.

In Oklahoma, 12 municipalities with populations ranging from 483 to 11,801 have sewage collection systems serving a total of 29,400 people. Quantitative information on industrial wastes discharged to sewers is not available. All of the municipalities have some type of sewage treatment. Pollution load is reduced by 76 percent prior to discharge to streams.

In addition to sewage from municipal sources, industrial wastes from 67 known significant sources are discharged to streams through separate outlets. Oil production and coal mining in Kansas and oil production, coal mining, and lead and zinc mining and smelting in Oklahoma are each classified as single sources of pollution since information on individual companies or operations is not available. Only general summaries of the conditions of each of these industries for these States are available.

Of the 67 sources of industrial wastes, 47 produce organic wastes (one of which also produces inorganic wastes) with a population equivalent of 84,000. Fourteen produce organic wastes (two of which also produce inorganic wastes) of undetermined amounts. Nine produce inorganic wastes including the three noted above also producing organic wastes.

In Arkansas, nine industries discharge organic wastes with a population equivalent of 6,800 to streams. Seven are seasonal canning plants, one a slaughterhouse, and one a poultry dressing plant. In addition five industries, including four slaughterhouses and one poultry processing plant discharge organic wastes of undetermined amounts. Four slaughterhouses have some type of wastes treatment.

In Kansas, 14 industries discharge organic wastes with a population equivalent of 34,500 to streams. These include five meat packing plants, one rendering plant, four milk processing plants, one ice plant, one feed lot, and two refineries. One distillery, one wax plant, two railroads, one chemical company, and the oil fields as a group discharge organic wastes of undetermined amounts. The chemical company and oil fields also discharge inorganic wastes. Two lead and zinc smelters and the coal mines as a group

also discharge inorganic wastes of undetermined quantities. Acid mine drainage causes serious local pollution in several areas, especially in the Spring River watershed. One meat packing plant, two milk processing plants, two refineries, chemical plant, wax plant, and oil fields have some type of wastes treatment. Considerable salt water drains to the Cottonwood and Neosho Rivers in Kansas. Most slugs were traced to the North Virgil Pool in Greenwood County. Regular sampling along these streams provides constant checks and brine pollution in the basin is at the lowest level that has occurred since the 1935 statutes covering oil field brines were established.

In Missouri, 22 industries discharge organic wastes with a population equivalent of 41,700 to streams. These include two meat packing plants, one rendering, one poultry processing, 14 canning, three milk processing plants, and one distillery. One roofing company discharges organic wastes of undetermined amounts and also inorganic acid refuse. Only one poultry processing plant and one milk processing plant have some type of waste treatment.

In Oklahoma, two paper products industries discharge organic wastes with a population equivalent of 1,000 to streams. A rubber plant and a milk processing plant discharge organic wastes of undetermined amounts. The oil fields and lead and zinc mining and smelting discharge inorganic wastes of undetermined amounts and coal mines discharge about 13 m.g.d. of water containing inorganic wastes varying in amounts and in polluting effects. The two paper plants, milk processing plant, some oil wells and some lead and zinc mines and smelters have some type of treatment. The rubber plant has no treatment and it is undetermined if coal mines treat their wastes.

Lead and zinc mines in the Tri-State Area represent a major potential source of pollution since iron contained in wastes may be as high as 6,000 ppm, acid may be over 8,000 ppm and a single operation may discharge several million gallons of wastes per day. Research has been carried on to determine methods for removal of wastes and recovery of by-products. The output of these industries may be limited by the amounts of waste which can be safely discharged to streams.

Data on the amount of pollution which reaches watercourses from coal, lead, and zinc mining in the Tri-States Area is not available. Inorganic wastes consisting of acids, toxic materials, and various other deleterious materials associated with such operations have been discharged to some streams as evidenced by the acidity of some tributaries. Attention has been focused to the problem by abatement measures taken for such operations in other parts of the country.

To summarize industrial pollution contributed to streams, the oil fields, lead and zinc mines and concentrating mills, and coal mines are potentially

also discharge inorganic wastes of undetermined quantities. Acid mine drainage causes serious local pollution in several areas, especially in the Spring River watershed. One meat packing plant, two milk processing plants, two refineries, chemical plant, wax plant, and oil fields have some type of wastes treatment. Considerable salt water drains to the Cottonwood and Neosho Rivers in Kansas. Most slugs were traced to the North Virgil Pool in Greenwood County. Regular sampling along these streams provides constant checks and brine pollution in the basin is at the lowest level that has occurred since the 1935 statutes covering oil field brines were established.

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To summarize industrial pollution contributed to streams, the oil fields, lead and zinc mines and concentrating mills, and coal mines are potentially

the greatest sources of pollution in the basin. Other sources would cause mostly locally bad conditions, but these industries could cause serious pollution in long reaches of important streams in the basin.

Sediment pollution occurs from natural or man-made causes. Some of those causes, primarily of natural origin, are the character of surface geology and topography or the denuding of vegetation cover by drought periods which permits surface runoff to erode the barren lands. Man-made causes of sediment pollution are important in some local areas from ore and coal washing operations. Streams in the basin, in general, are relatively free of sediment and several tributaries are exceptionally clear most of the time. In the headwaters of the main stem and the Cottonwood River, natural conditions produce sediment pollution. The large reservoirs in the lower reaches of the main stem retain practically all sediment and release clear water.

The waters in the basin are low in mineral content. Salt springs near Salina, Oklahoma, contribute natural salinity but the discharge is small and insignificant so far as general water quality is concerned.

DAMAGES TO WATER RESOURCES FROM POLLUTION

Damages to water resources from pollution in the Grand (Neosho) River Basin may be considered under two general categories, namely, the existing or specific damages, and the potential damages, those which may result from the use of polluted waters. Practically all primary water uses in the basin are affected to some degree by pollution originating from municipal, industrial, or natural sources.

Waters obtained for domestic use from polluted surface sources require more extensive and expensive treatment to assure production of a potable supply for the consumer. High concentrations of bacteria, taste and odor-producing substances, and organic and inorganic chemicals affect the suitability of the water for various domestic uses and may jeopardize the health of consumers due to the ever present hazard of contamination not being completely removed from treated water. The undesirable impurities increase the amounts of chemicals, type and size of plant, and number and vigilance of employees required to assure satisfactory treatment to the finished supply.

Waters obtained from polluted surface supplies for industrial use may be subject to some or all of the detrimental effects mentioned for production of a domestic supply and possibly additional expense and risk dependent upon the quality of water required for the industrial process.

The loss of livestock resulting from the use of polluted streams for watering also presents a potential economic loss in this region dependent upon livestock raising for a large part of its economy.

The large and numerous lakes in the basin and the perennial flow in most of the streams present ideal conditions for the propagation of fish and wildlife and the pursuit of recreational activities, and these activities have considerable financial significance in the basin. Damage to waters which will harm aquatic life results from three main types of pollution:

(1) Organic pollution, originating mostly from domestic sewage and food-processing industries, reduces or depletes the oxygen content necessary for the support of fish life in the streams;

(2) Toxic materials, acids, and other inorganic wastes destroy fish or create an environment unsuitable for the production of water life used by fish as food;

(3) Sediment deposited in the watercourses covers plant and animal life used as sources of fish food and also destroys natural spawning areas. Sediment pollution presents the additional disadvantage of impairing the ability of streams to recover from organic pollution.

Sediment is a relatively minor problem in the basin but sources of the other types of pollution represent a serious potential threat to basin water resources.

A number of intangible damages result from pollution of streams. Aesthetic values deteriorate from the unpleasant appearance and odors from polluted rivers, lowering values of surrounding areas and affecting the enjoyment of living nearby.

A few typical cases of damages in the basin are presented as a matter of illustration and interest primarily, since they are either in the process of solution or because they are potential, rather than existing, sources of pollution.

The output of lead and zinc mines and concentration mills in the Tri-State areas has been limited by the amounts of wastes which could be discharged to streams without danger of contamination which would be injurious to fish, livestock, crops, and human beings. In the past suits have been filed, most of which were settled out of court regardless of the merits of each case. The wastes from a single plant would produce many tons of iron sludge and other salts if wastes were discharged to streams. There may be 60 or more separate mills and many more mines.

Before 1949 the City of Joplin treated its sewage before discharge to Turkey Creek by means of a septic tank built in 1917. The septic tank was inadequate as to size and quality of treatment required. Complaints were received from residents in Missouri and Kansas which finally resulted in construction of two complete treatment plants in 1949 and 1950 to treat all of the city's wastes.

In the summer of 1952 complaints were received from the Joplin area indicating that Turkey Creek is being polluted by flesh and blood from a slaughtering and rendering plant, pulp waste, and acid refuse from a roofing company, and mine sludge. Claims of fish kills, odors, filth deposits, and unhealthful conditions have been submitted. The problem is being studied for action.

The Town of Afton, Oklahoma, has recently voted bonds for a new sewage disposal plant and is in the process of planning for the construction of this facility. An examination of the circumstances leading to this action by the Town of Afton is of interest as an example. As far back as 1920, complaints were received by the Oklahoma State Department of Health concerning the inadequate method of treatment of municipal wastes employed at Afton. Infrequent complaints were received in the intervening years between 1920 and 1946, but since 1946 there have been many complaints. One of the reasons for the increase in complaints was that the inadequate sewage plant of Afton had become run down and had ceased to operate properly because

of lack of maintenance and operation. To facilitate sewage removal from the town, the outfall main was broken approximately 100 feet above the septic tank, allowing raw sewage to be discharged directly into Horse Creek.

This break was found during an inspection made on January 14, 1946, by representatives of the State and County health departments. The creek below the plant and for one-fourth mile downstream was acting as a septic tank. The stream was 30 to 40 feet wide in many places, making an ideal condition for settling the sewage particles to the bottom where they decomposed and formed black and odorous sludge banks. Horse Creek drains into Grand Lake o' the Cherokees, and the municipal water intake of the City of Vinita is located below the Afton sewage outfall on the same arm of the lake. This condition represents a serious health hazard, even though the water is treated by Vinita before use. Recommendations were made to the City of Afton to eliminate the pollution by providing adequate treatment facilities, but an order by the Commissioner of Health on November 23, 1948, was necessary to initiate action.

Insanitary conditions also exist in the streams below Commerce, Picher, and Quapaw due to their inadequate and run-down sewage treatment plants. An order has been issued to Commerce to construct needed improvements and recommendations have been made to the remaining towns to install new or enlarged treatment plant facilities to dispose of their domestic wastes and to avoid the pollution of streams which must be used by others downstream.

BENEFITS RESULTING FROM POLLUTION PREVENTION AND ABATEMENT

In a consideration of benefits resulting from pollution prevention and abatement, it can be stated generally that all legitimate water uses derive some degree of benefit, either directly or indirectly, from a program of pollution control. In a broader sense, the benefits may be applied to the conservation and development of our fundamental human, land, and water resources. In some cases the benefits can be evaluated on a monetary basis and are regarded as tangible benefits. Most generally prevailing, however, are the intangible benefits to public health, recreation, aquatic life, and purely aesthetic considerations, which are equally real and justified, but because of their nature cannot readily be assigned a specific or monetary value.

Several communities using surface waters, and a greater number using ground waters as sources for public supplies in the basin, will be confronted with critical water shortages when there is an increase in demand resulting from anticipated population growth and industrial development. Protecting the available surface waters from pollution will make them available for new sources of supply and permit optimum use of the existing supplies. Pollution abatement will also permit municipal water treatment plants now treating polluted water to operate at less cost and with a greater factor of safety from a public health standpoint.

Water must be protected from pollution to satisfy the future needs of existing industries and the anticipated needs of new industries. Any improvement in the quality of water available for industrial use will decrease the cost of treatment and thus serve as a direct financial inducement to industrial expansion and development. Other direct benefits to industry often result from waste recovery measures. An illustration is the problem presented in the Tri-State area of the basin where iron hydroxide sludge is removed from the zinc mine wastes. A potential market for this waste has been found in the manufacture of cement, which is produced nearby. At least one coal mining operation has installed a by-products plant which recovers substantial quantities of black coal and pyrites.

Prevention and abatement of pollution will preserve the streams and lakes for continued intensive use for fishing, wildlife preservation, and recreation. Fishing as a recreation pursuit is exceptionally important throughout most of the basin. Water quality required for safe swimming is very critical. Several of the lakes and streams have extensive permanent type developments for recreation. Pollution must be prevented to preserve the use of waters for this purpose and avoid damage to extensive permanent developments.

Prevention of livestock losses attributed to pollution will result in immediate and direct economic benefits to the important livestock raising industry, and the cost incident to the settlement of damages by polluters can be reduced or eliminated.

The aesthetic quality of a stream has real value. Elimination of floating material, sludge banks, discoloration, foul odors, and other nuisance conditions will render surface waters attractive for many water uses and restore or enhance property values along the watercourses.

In the final analysis of benefits resulting from pollution prevention and abatement it can be stated that pollution abatement is not an objective which requires complete justification on a balance sheet; it is one of the necessities for survival.

POLLUTION PREVENTION MEASURES IN EFFECT

Considerable progress in providing pollution control measures for the protection of surface water resources of the basin has been made in recent years. The work that has been done has been achieved through the program activities of the State health departments in cooperation with other State agencies, municipalities, industries, and other groups having interest in the conservation of water resources. This progress has been primarily in the field of treatment of wastes from municipalities, but some progress has been made in treatment of wastes from existing industries. Several large industries, which discharge large quantities of strong wastes capable of producing serious problems, have partially or completely solved their problems by construction of treatment facilities. There remain many municipal and industrial plants with unsatisfactory treatment because the design capacity or type of treatment is inadequate; a few municipalities and many industries have no plants. Pollution problems are also presented by a number of municipalities and industries due to unsatisfactory operation of plants.

A summary of the available data on existing municipal waste treatment plants is shown in Table C. Of the 55 municipalities listed as sources of pollution, 46 provide some degree of treatment. Seven primary treatment plants serve eight municipalities and 7,500 people. The primary plant at Picher, Oklahoma, also serves Cardin, Oklahoma. Thirty-nine secondary treatment plants serve 38 municipalities and about 158,000 people. Nine municipalities, representing a population of about 27,200, have no waste treatment facilities.

In Arkansas, two municipalities serving 3,650 persons have secondary treatment plants.

In Kansas, one municipality has a primary treatment plant serving 950 persons. Twenty-one secondary treatment plants serve 76,500 persons in 20 municipalities. Columbus has two secondary plants. Six municipalities, representing a sewer connected population of 21,050, provide no waste treatment facilities.

In Missouri, two municipalities have primary treatment works serving 475 persons. Nine municipalities have secondary treatment serving about 54,300. Three municipalities with a total of 6,200 persons provide no waste treatment.

In Oklahoma, five municipalities with a population of 6,050 are served by four primary treatment plants. Seven municipalities have secondary treatment facilities serving 2,350 persons.

Table D is a summary of available data regarding existing industrial waste treatment facilities. Sixty-seven industries are considered to be significant sources of pollution discharging directly to watercourses. Of these industries, 21 are known to have some type of waste treatment; 41 discharge wastes without treatment; and information is not available for five industries.

In Arkansas, 14 industries are considered significant sources of pollution, of which five have waste treatment facilities, seven have none, and two are undetermined. The four waste treatment facilities serve slaughterhouses. One slaughterhouse, six canning plants and two poultry processing plants have no treatment. Facilities, if any, provided by one slaughterhouse and one canning plant have not been determined.

Of 23 significant sources of industrial pollution in Kansas, nine have waste treatment facilities, 12 have none, and two are undetermined. Some type of treatment facilities serve two milk processing plants, one meat packing plant, two refineries, one wax plant, one chemical company, and some of the oil fields. No waste treatment is provided by four meat packing plants, one rendering plant, two milk plants, one ice plant, one feed lot, one distillery, one railroad, and one lead and zinc concentrating mill. Facilities provided by one lead and zinc smelter and the coal mines in the basin have not been determined.

In Missouri there are 23 sources of industrial pollution, of which two have waste treatment facilities and 21 have none. Waste treatment plants serve one milk processing plant and one poultry processing plant.

In Oklahoma, there are seven major sources of industrial pollution, of which five have waste treatment facilities, one has none, and one is undetermined.

Waste treatment facilities serve some lead and zinc mining and smelting plants, some oil fields, two paper mills, and one milk processing plant. One rubber plant has no treatment and treatment facilities for coal mines are undetermined.

The adequacy of existing municipal and industrial waste treatment facilities in the basin is indicated in Tables E and F. Of the 46 municipal sewage treatment plants, 28 are considered by State authorities to be adequate in capacity and 34 are satisfactorily operated. Only six, of a total of 21, industrial waste treatment facilities are considered adequate in capacity and only six are properly operated.

In Arkansas, the two municipal sewage treatment plants in the basin are adequate as to type and capacity and both are operated satisfactorily. Two industrial waste treatment plants are adequate with respect to capacity and two are satisfactorily operated.

In Kansas, 14 municipal sewage treatment plants are adequate as to type and capacity and eight are inadequate. Eighteen are operated satisfactorily and four unsatisfactorily. Three industrial waste disposal facilities are of satisfactory type and capacity and six are inadequate. Three industrial facilities are operated satisfactorily, five are not properly operated, and the quality of operation of one is undetermined.

In Missouri, eight municipal plants are adequate as to type and capacity and three are inadequate. Eight are operated satisfactorily and three unsatisfactorily. Two industrial sources of pollution provide inadequate treatment facilities and both plants are unsatisfactorily operated.

In Oklahoma, four community sewage treatment plants are adequate as to type and capacity and seven are inadequate. Six are operated satisfactorily, four unsatisfactorily, and one is undetermined. One industrial waste treatment facility is adequate in type and capacity, one is inadequate and three are of undetermined capacity and efficiency.

Table G shows available information on recent progress in construction of pollution abatement facilities. A total of 16 municipal sewage treatment plants or major plant improvements, with total design capacity of 263,650, were constructed in the period 1946-1952. Two projects were constructed in Arkansas to serve 8,650 persons; five were constructed in Kansas to serve 105,000 persons; five were constructed in Missouri to serve 70,250 persons; and four were constructed in Oklahoma to serve 79,750 persons.

No specific information is available regarding progress in construction of pollution abatement facilities for industries during the period 1946-1952. It is likely that some of the existing industrial waste treatment facilities were constructed in the period. Continued improvement in chloride readings in the Cottonwood River Basin indicates better care is being taken of wastes.

The cooperating departments of States in the basin have various functions and authority concerning the water pollution control problem. A brief resume of the organization in each State follows.

In Arkansas the Water Pollution Control Commission within the State Board of Health has authority and responsibility for water pollution prevention and abatement. The Commission was created by comprehensive water pollution control legislation enacted in 1949 by the Arkansas General Assembly. However, the work of the Commission has been critically hampered by the fact that no State funds have been appropriated to carry out its program.

In Kansas, the Division of Sanitation carries on comprehensive program activities encompassing municipal, oil field, and other industrial wastes problems. The program activities of the Division are broad in scope and

are directed toward abatement of pollution by education, promotion and enforcement.

The State of Kansas has pioneered in the development of reinjection wells for oil field brine disposal. The Oil Field Section of the Division of Sanitation conducts a program of inspection, education, and enforcement in controlling pollution of fresh water resources by oil field brine. Continued research and study is sponsored by the Oil Field Section, in cooperation with other agencies, in its efforts to control pollution from oil fields in the State.

In Missouri, the Division of Health exercises certain control over stream pollution through the broad powers delegated to the Director of the Department of Public Health and Welfare. Additional legislation has been under the jurisdiction of the Conservation Commission. Enforcement provisions of existing regulations and laws, however, are inadequate to support the stream pollution control agencies in their efforts to cope with all pollution problems.

In Oklahoma, the division of interests and activities involving water pollution control places responsibility for pollution originating from municipal sources generally with the State Department of Health. The Planning and Resources Board and the Corporation Commission exercise control over industrial pollution, particularly from oil fields, and the Game and Fish Department maintains surveillance over sources of pollution and initiates legal action in cases which affect the fish and wildlife resources of the State.

All States in the basin have legislation permitting construction of sewers and sewage treatment facilities by issuance of general obligation bonds and special improvement bonds. The total amount of general obligation bonds which can be issued and the amount of special improvement bonds which can be issued for each purpose is limited. These financing methods alone are often not adequate to enable construction of needed pollution control facilities.

Arkansas legislation has permitted the issuance of revenue bonds and collection of sewer service charges to construct and maintain sewerage facilities since 1933. Missouri has had similar laws since 1951. The laws need minor changes to permit greater flexibility of use and to enable the States to take advantage of recent Federal laws which provide for assistance to States in financing water pollution control facilities.

Kansas has had laws since 1947 permitting issuance of revenue bonds for acquiring and maintaining utilities. These laws did not specifically include sewerage facilities until an amendment was passed in 1953.

Oklahoma has no law permitting issuance of revenue bonds for construction and operation of municipal sewerage facilities.

The Federal Government recognizes that the responsibility for water pollution control rests primarily with the States, but also regards conservation of the water resources as a national concern. Federal legislation was enacted in 1948 to assist the States in their program activities. The provisions of the Federal Water Pollution Control Act, Public Law 845, 80th Congres, have stimulated water pollution control activities by providing technical service assistance and making Federal funds available for the conduct of investigations, research, surveys, and studies related to the prevention and control of water pollution caused by industrial wastes.

Although most of the streams in the basin are exceptionally free of silt, the moderately heavy suspended sediment loads carried by a few tributaries indicate serious local soil conservation problems. Much is being done by the farmer with the cooperation of State and Federal agencies to reduce natural sources of sediment pollution.

TABLE C

EXISTING TREATMENT FACILITIES

MUNICIPAL

Degree of Treatment Provided	Number of Municipalities Served				Number of Treatment Plants				Population Served			
	A	K	M	O	A	K	M	O	A	K	M	O
Primary	0	1	2	5	0	1	2	4	0	950	475	6,050
Secondary	2	20	9	7	2	21	9	7	3,650	76,500	54,290	23,350
No Treatment	0	6	3	0	0	6	3	0	0	21,050	6,200	0

TABLE D

EXISTING TREATMENT FACILITIES

INDUSTRIAL

Type Industry	Number of Plants				Number of Industrial Plants Having:											
					Treatment Facilities				No Treatment Facilities				Undetermined Facilities			
	A	K	M	O	A	K	M	O	A	K	M	O	A	K	M	O
Food & Kindred Products	14	12	21	1	5	3	2	1	7	9	19	0	2	0	0	0
Rendering	0	1	1	0	None				0	1	1	0	None			
Paper & Allied Products	0	0	0	2	0	0	0	2	None				None			
Oil Production Industry	0	3	1	0	0	3	0	0	0	0	1	0	None			
Rubber Production Industry	0	0	0	1	None				0	0	0	1	None			
Lead & Zinc Mining Smelting	0	2	0	1	0	0	0	1	0	1	0	0	0	1	0	0
Coal Mining	0	1	0	1	None				None				0	1	0	1
Chemical & Allied Products	0	1	0	0	0	1	0	0	None				None			
Oil Fields	0	1	0	1	0	1	0	1	None				None			
Transportation	0	2	0	0	0	1	0	0	0	1	0	0	None			
TOTALS	67				21				41				5			

A - Arkansas K - Kansas M - Missouri O - Oklahoma

TABLE E

ADEQUACY OF EXISTING TREATMENT FACILITIES
MUNICIPAL

State	Number of Municipal Treatment Facilities	Adequacy with Relation to:					
		Capacity			Operation		
		Satisf.	Unsatisf.	Undetermined	Satisf.	Unsatisf.	Undetermined
Ark.	2	2	0	0	2	0	0
Kans.	22	14	8	0	18	4	0
Mo.	11	8	3	0	8	3	0
Okla.	11	4	7	0	6	4	1

TABLE F

ADEQUACY OF EXISTING TREATMENT FACILITIES
INDUSTRIAL

State	Number of Municipal Treatment Facilities	Adequacy with Relation to:					
		Capacity			Operation		
		Satisf.	Unsatisf.	Undetermined	Satisf.	Unsatisf.	Undetermined
Ark.	5	2	3	0	2	3	0
Kans.	9	3	6	0	3	5	1
Mo.	2	0	2	0	0	2	0
Okla.	5	1	1	3	1	1	3

TABLE G

PROGRESS IN CONSTRUCTION OF POLLUTION ABATEMENT FACILITIES

Year	Municipal		Industrial	
	Sewage Treatment Plants Completed	Design Population	Waste Treatment Plants Completed	Amount of Waste Treated (In Terms of Equiv. No. People)
1946	Okla. 1	12,500	No data	
1947	--	--		
1948	--	--		
1949	Ark. 1 Mo. 4	7,200 25,250		
1950	Ark. 1 Mo. 1	1,450 45,000		
1951	Okla. 1	1,250		
1952	Kans. 5 Okla. 2	105,000 66,000		
TOTALS	16	263,650		

POLLUTION PREVENTION MEASURES REQUIRED

The measures required for pollution prevention and abatement expressed herein are based on information available at the writing of this report. The needs are not intended to be complete and final but are subject to changes and re-evaluation as additional data become available through continued studies and investigations.

The program activities of the State water pollution control agencies have expanded of necessity in the past years to cope with the increasing pollution resulting from urban growth and industrial development. The need for legislative authority for support of water pollution control activities became apparent in Kansas as early as 1885, and in 1907 the first anti-stream pollution law passed. Similar action by Oklahoma was taken 10 years later.

Although most of the municipalities in the basin have some type of sewage treatment facility, there is indicated an immediate need for a number of treatment plants where no treatment is now provided and for the expansion or improvement of a substantial number of existing plants to render them adequate and effective for protection of the receiving waters.

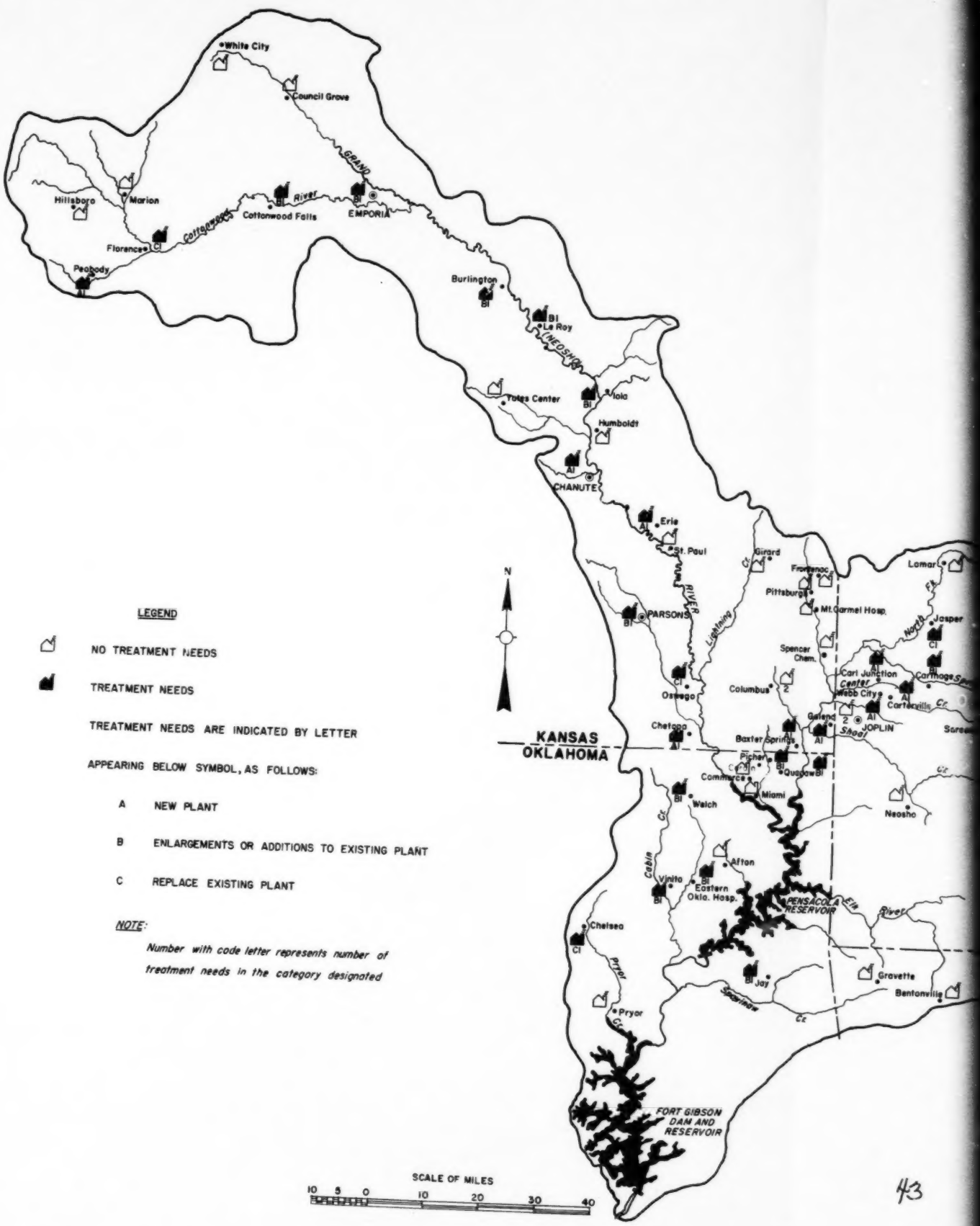
Tables H and I are summaries of the municipal and industrial pollution abatement needs in the basin.

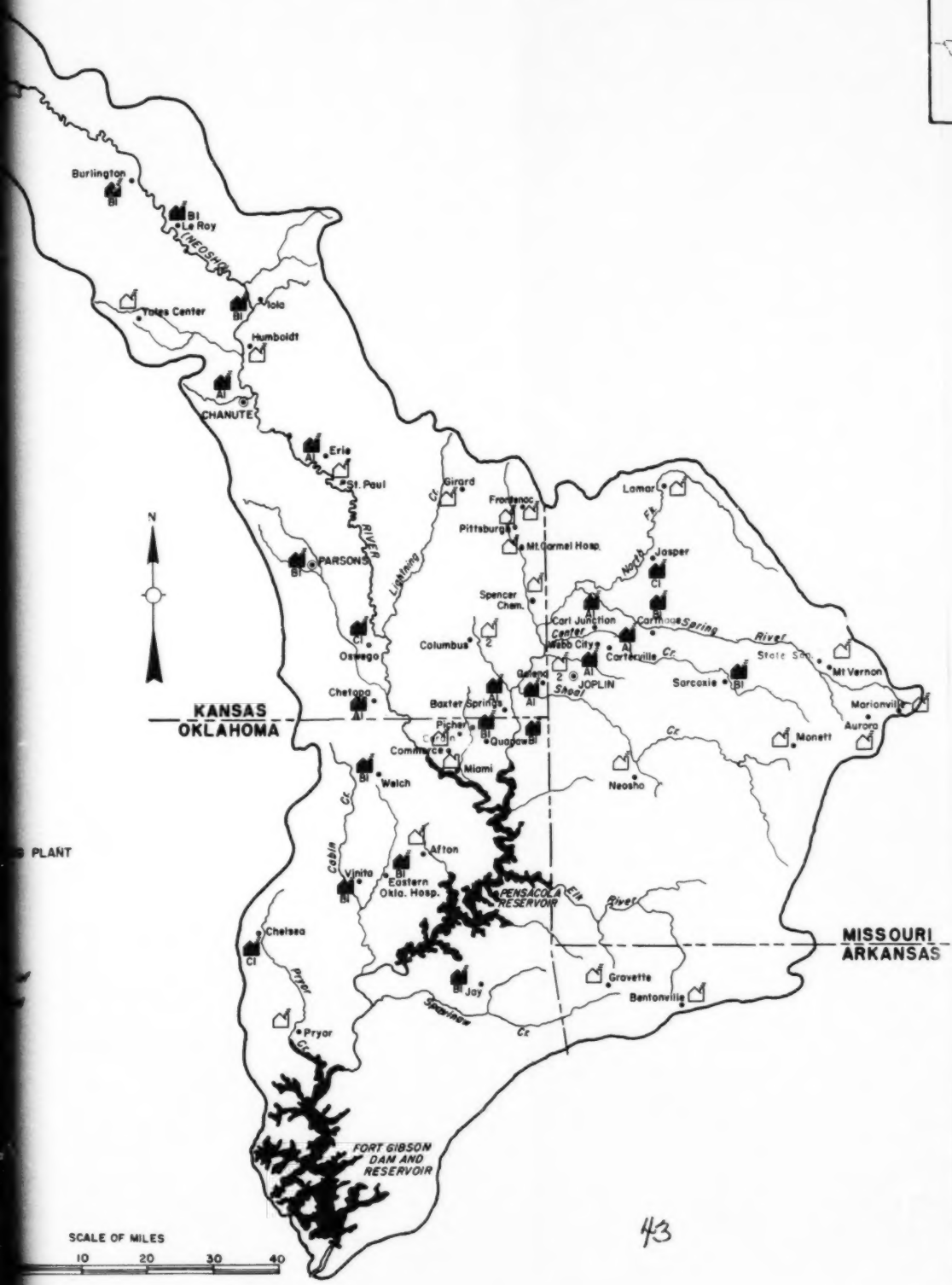
Nine municipalities, with a combined sewered population of more than 27,000, need new plants for the treatment of wastes. Fourteen communities serving about 57,500 persons, need enlargements or additions to existing plants to increase capacities, improve operation, or provide secondary treatment units. Four communities representing a total population of about 4,300, should replace obsolete existing facilities. Twenty-eight municipal plants, serving a population of 103,500, need no improvements. Map No. 4 shows the locations and waste treatment needs of basin municipalities.

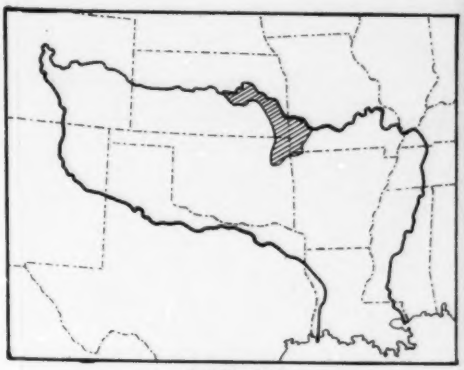
Thirty-four basin industries need new waste treatment plants or other pollution control facilities, six should enlarge or add to existing treatment works, and the needs of 18 industrial establishments have not been determined. Only six industries have adequate waste treatment facilities. Industrial pollution abatement needs are shown on Map No. 5.

In Arkansas, there are no municipal pollution abatement needs within the basin and two industries have provided adequate waste treatment facilities. However, the needs of 12 industries have not been determined.

In Kansas, six municipal systems serving 21,050 people need new sewage treatment plants; six serving 38,950 need enlargements or additions; two serving 3,150 need replacement of existing plants; and 14 serving 35,350 have no needs. Eleven industries need new waste treatment facilities;


White City
Council Grove
GRAND
River
Hillsboro
Marion
Cottonwood
Cottonwood Falls
EMPORIA
Florence
Peabody
Burlington
La Roy
NEOSHO
Yates Center
Iola
Humboldt
CHANUTE
Erie
St. Paul
Girard
Lamar
Pittsburg
Mt. Carmel Hosp.
PARSONS
Lightning
Spencer Chem.
Carl Junction
Carthage
Oswego
Columbus
Webb City
Cartersville
Galena
JOPLIN
Chetopa
Baxter Springs
KANSAS
OKLAHOMA
Picher
Quapaw
Commerce
Miami
Welch
Neosho
Cabin
Afton
Vinita
Eastern Okla. Hosp.
PENSACOLA RESERVOIR
Elk River
Chelsea
Pryor
Jay
Gravette
Bentonville
Sprin
FORT GIBSON DAM AND RESERVOIR
N
LEGEND
NO TREATMENT NEEDS
TREATMENT NEEDS
TREATMENT NEEDS ARE INDICATED BY LETTER
APPEARING BELOW SYMBOL, AS FOLLOWS:
A NEW PLANT
B ENLARGEMENTS OR ADDITIONS TO EXISTING PLANT
C REPLACE EXISTING PLANT
NOTE:
Number with code letter represents number of treatment needs in the category designated
SCALE OF MILES
10 5 0 10 20 30 40





GRAND (NEOSHO) RIVER BASIN

MUNICIPAL WASTE TREATMENT NEEDS

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Division of Water Pollution Control
MAP NO. 4

LEGEND

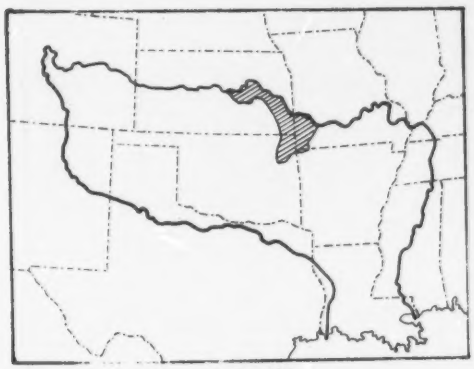
WASTE TREATMENT NEEDS

OIL FIEL	OTHER INDUSTRY	
		NO NEEDS
		NEEDS UNDETERMINED
		PROJECT NEEDED

TYPE OF PROJECT IS INDICATED BY CODE LETTER APPEARING BELOW PROJECT NEEDED SYMBOL, AS FOLLOWS:

- A NEW PLANT
- B ENLARGEMENT ADDITIONS TO EXISTING FACILITIES
- C REPLACE EXISTING FACILITIES

NUMBER NEXT TO SYMBOL REPRESENTS NUMBER OF NEEDS IN THE AREA IN THE CATEGORY DESIGNATED



GRAND (NEOSHO) RIVER BASIN

INDUSTRIAL
POLLUTION ABATEMENT NEEDS

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
Public Health Service
Division of Water Pollution Control
MAP NO. 5

Five need enlargements or additions; one needs replacement; and the needs of three are undetermined. As previously stated all coal mines and all oil fields in the basin are classified as a single source of pollution. The needs of coal mines are undetermined. Since some oil wells dispose of part or all of their brine, the needs for the oil fields as a whole are enlargements and additions to facilities to care for wastes. In addition there are many lead and zinc mines, concentrating mills, and smelters. Data on industrial waste production for most of these individual industries are not available.

In Missouri, three municipalities serving 6,200 people need new sewage treatment plants; two serving 8,400 need enlargements or additions; one serving 75 persons needs to replace an existing plant; and eight serving 46,300 have no needs. Twenty-two industries need new waste treatment facilities and one should enlarge an existing plant.

In Oklahoma, six municipalities serving 10,200 persons need enlargements or additions to existing plants; one serving 1,050 needs replacement of existing plant; and four serving 18,150 have no needs. One industry needs new waste treatment facilities; one needs enlargements or additions; and the needs of three industries are undetermined. In the Oklahoma portion of the basin, all of the lead and zinc mining and smelting, all of the coal mines, and all of the oil fields are classified as single sources of pollution. As a result, all lead and zinc operations are classified as having no needs. Coal mines have undetermined needs. Oil fields need enlargements and additions of waste treatment facilities.

Tables J and K show the current status of action on known municipal and industrial pollution abatement needs. Eleven municipalities have taken no action on their needs, two are actively planning, one has final plans approved; two have plants under construction; and the status of action for 11 municipalities where needs are known is undetermined. Thirty-five industries have taken no action on their needs; two are actively planning; two have facilities under construction; and the status of action for seven industries, where needs are known, is undetermined.

In Arkansas, no action is required for abatement of municipal pollution. The status of action by 12 industries, for which pollution abatement needs have not been determined, toward provision of waste treatment facilities has not been determined.

In Kansas, four municipal plants are under construction, no action is being taken on one needed project, and the current status of 11 projects is undetermined. Thirteen industrial projects are inactive, one plant is under construction, and the status of three projects is undetermined.

In Missouri, five municipalities have taken no action toward provision of required improvements and one community is actively planning adequate facilities. Twenty-one industrial projects are inactive, one industry is actively planning to provide additional facilities, and the status of one industrial project is undetermined.

In Oklahoma, five municipalities have taken no action, one is engaged in active planning, and one has final plans approved. Of three industrial projects, one is actively planned, one is under construction, and the other is inactive.

Table L lists the municipalities and the industries needing specific or undetermined types of projects. For industries discharging organic type wastes, a population equivalent based on actual data or a theoretical value computed from plant output is shown, if either data are available.

It is estimated that the initial cost of the required municipal waste treatment facilities in the Grand (Neosho) River Basin would be approximately $3,500,000. This is based on average construction costs considered reasonable for this area and includes the cost of new treatment plants, additions or improvements to existing plants, and replacement of inadequate, obsolete, and worn-out plants. The estimate includes the cost of providing treatment for the industrial wastes discharged to municipal sewers for the Kansas and Missouri portions of the basin. Data on industrial wastes discharged to municipal sewers in the Arkansas and Oklahoma portions of the basin are not available.

There is insufficient information available on the sources of industrial pollution and the nature and magnitude of individual and collective problems to determine the number and types of waste treatment facilities needed. These deficiencies of information, in addition to the complex engineering required to determine good economical methods for treatment of some industrial wastes, preclude estimating of costs of facilities needed for treatment of industrial wastes.

The importance of the wastes produced by oil fields, coal mines, and lead and zinc mines and mills as potential sources of pollution is greater than any other wastes discharged to streams in the basin. Specific data on individual operations is needed to determine the quantities of wastes, adequacy of waste treatment methods, and needs, so that major damages can be avoided.

Although most streams in the basin are relatively clear, moderately large sediment loads are carried by a few streams. Soil conservation programs in the basin should be expanded and intensified to prevent or control the damage to land and water resources represented by silt pollution.

Water resources represent a major economic asset of the basin. The objective of water pollution control programs is preservation and development of those resources. Adequate legislation and operating funds for pollution control enforcement agencies are essential to sound water resource development.

Water pollution control program activities in Missouri have been hampered in the past, mainly because of lack of legislative authority necessary to enforce the existing State anti-pollution regulations and laws, and partly because of insufficient funds made available to the Division of Health. Comprehensive legislation is needed in Missouri to support the designated agencies in their program activities.

Although comprehensive water pollution control legislation has been in effect in Arkansas since 1949, the program activities of the State Water Pollution Control Commission have been handicapped and delayed because of the lack of sufficient funds. The State Legislature should recognize this need and appropriate funds commensurate with the responsibilities imposed on the Commission to permit continued and expanded program activities.

In Oklahoma, experience has demonstrated the limitations of divided responsibility for the administration of existing water pollution control laws among several departments of the State government. It is recognized as desirable, therefore, that administrative responsibility be coordinated to assure that all sources of pollution are adequately controlled and that program activities of each agency complement and support those of the other agencies concerned.

Financing laws in Arkansas and Missouri, although generally adequate, need some revisions to make them serve their purpose better for the construction of pollution abatement and prevention facilities. The law in Kansas permitting revenue bond issues for acquisition and maintenance of utilities was modified in 1952 to include sewerage facilities. Oklahoma needs a law to permit issuance of revenue bonds for construction and operation of sewerage facilities.

In order to prevent further degradation of the quality of waters, now seriously polluted in some areas, which may occur from future population growth and industrial development, more urgency should be attached to the correction of existing bad conditions. Serious pollution problems develop more frequently from slow and sometimes almost imperceptible deterioration in water quality than from sudden and spectacular quality changes. Waste treatment requirements should be based on reasonable development of water resources for productive use rather than maintenance of existing stream conditions or correction of nuisances.

Effective operating programs require adequate administrative and technical personnel, necessary equipment and facilities, and sufficient funds for all essential activities. The program objectives should accomplish, through further studies and investigations, a comprehensive evaluation of the pollution problems, recommendations for their solution, and finally, the active sponsoring of remedial measures required. When essential for the solution of particular industrial waste problems, cooperative investigations and research projects between the State and industry should be initiated by the responsible water pollution control agencies.

The support of the public and leaders of industry is essential to effective water pollution control programs. The public is rarely fully aware of the damages to productive water uses resulting from pollution or of the benefits accruing from preservation of water resources. State programs of public information and education reaching citizens in all walks of life serve to create greater public demand and cooperation for water resource development and reasonable pollution abatement measures.

TABLE H

WASTE TREATMENT NEEDS - MUNICIPAL

Needs	Number	Population Served by Facilities
New Plant	Kans. 6 Mo. 3	21,050 6,200
Enlargement or Additions to Existing Plant	Kans. 6 Mo. 2 Okla. 6	38,950 8,400 10,200
Replace Existing Plant	Kans. 2 Mo. 1 Okla. 1	3,150 75 1,050
No Project Required	Ark. 2 Kans. 14 Mo. 8 Okla. 4	3,650 35,350 46,290 18,150
Undetermined	None	None

TABLE I

INDUSTRIAL WASTE POLLUTION ABATEMENT NEEDS

Needs	Number
New Treatment Plant or Other Pollution Control Measures	Kans. 11 Mo. 22 Okla. 1
Enlargement or Additions to Existing Plant	Kans. 5 Mo. 1 Okla. 1
Replace Existing Plant	Kans. 1 Okla. 1
Connection to Municipal Sewer System	None
No Project Required	Ark. 2 Kans. 3 Okla. 1
Undetermined	Ark. 12 Kans. 3 Okla. 3

TABLE J

CURRENT STATUS OF MUNICIPAL ACTION ON

POLLUTION ABATEMENT NEEDS

Status of Action	Number of Municipalities	
Inactive	Kansas	1
	Missouri	5
	Oklahoma	5
Active Planning	Missouri	1
	Oklahoma	1
Final Plans Approved	Oklahoma	1
Under Construction	Kansas	2
Undetermined	Kansas	11

TABLE K

CURRENT STATUS OF INDUSTRIAL ACTION ON

POLLUTION ABATEMENT NEEDS

Status of Action	Number of Industries	
Inactive	Kansas	13
	Missouri	21
	Oklahoma	1
Active Planning	Missouri	1
	Oklahoma	1
Final Plans Approved	None	
Under Construction	Kansas	1
	Oklahoma	1
Undetermined	Arkansas	12
	Kansas	6
	Missouri	1

TABLE L

MUNICIPALITIES AND INDUSTRIES NEEDING
IMPROVEMENTS FOR ABATEMENT OF POLLUTION

Name and Location	Population Served	Improvements Needed *	Remarks
KANSAS			
Municipalities			
Baxter Springs	4,500	NP	
Burlington	2,000	E-A	
Chanute	9,450	NP	Under construction; includes industrial wastes P.E. = 450
Chetopa	1,500	NP	
Cottonwood Falls	750	E-A	
Emporia	13,200	E-A	Includes ind. P.E.= 200
Erie	1,750	NP	Includes ind. P.E.= 600
Florence	950	R	
Galena	3,800	NP	
Iola	7,700	E-A	Includes ind. P.E.= 2,000
Le Roy	500	E-A	
Oswego	2,700	R	Includes ind. P.E.= 500
Parsons	23,000	E-A	Under construction; includes ind. P.E. =6,000
Peabody	1,100	NP	
Industries			
Chanute			
1 railroad	Und.	NP	
2 refineries	1,550	E-A	
1 wax plant	Und.	E-A	
Cherokee Co.			
9 strip coal mines	Und.	Und.	
Crawford Co.			
3 strip coal mines	Und.	Und.	
Labette Co.			
1 strip coal mine	Und.	Und.	
Columbus			
1 ice company	200	NP	
Dwight			
1 dairy products company	300	NP	
Emporia			
2 meat packing companies	6,700	NP	

TABLE L cont'd

Sheet 2 of 4 Sheets

Name and Location	Population Served	Improvements Needed *	Remarks
Frontenac			
1 meat packing company	900	R	
Galena			
1 distillery	Und.	NP	
2 lead & zinc smelters	Und.	Und.	
Iola			
1 milk company	900	NP	
Oil Fields	Und.	E-A	Fields scattered throughout basin; no specific data; some serious problems
Parsons			
1 meat packing co.	450	NP	
1 railroad shop	Und.	E-A	
1 animal feed lot	14,000	NP	Pollution when precipitation occurs
Pittsburg			
1 meat packing co.	7,200	NP	
MISSOURI			
Municipalities			
Carl Junction	500	NP	
Carterville	1,200	NP	
Carthage	8,000	E-A	
Jasper	75	R	
Sarcoxie	400	E-A	
Webb City	4,500	NP	
Industries			
Anderson			
1 canning company	1,500	NP	
Bethpage			
1 canning company	1,250	NP	
Carthage			
2 milk companies	530	NP	
Corsicana			
1 canning company	750	NP	
Exeter			
3 canning companies	3,900	NP	
Jasper			
1 milk company	1,229A	NP	
Joplin			
2 meat packing companies	10,000	NP	
1 rendering company	3,600	NP	

TABLE L cont'd

Name and Location	Population Served	Improvements Needed *	Remarks
Joplin (cont'd)			
1 distillery	7,875	NP	
1 roofing company	-	NP	Pulp waste-acid refuse
Monett			
1 canning company	1,875	NP	
Marionville			
1 canning company	900	NP	
Pierce City			
1 canning company	1,500	NP	
Pineville			
1 poultry dressing company	300	E-A	
1 canning company	1,500	NP	
Ridgedale			
1 canning company	1,500	NP	
Ridgley			
1 canning company	1,200	NP	
Verona			
1 canning company	1,050	NP	
Wheaton			
1 canning company	1,350	NP	
ARKANSAS			
Municipalities			
None			
Industries			
Bentonville			
1 slaughterhouse	135	Und.	
Best			
1 canning company	450	Und.	
Centerton			
1 slaughterhouse	Und.	Und.	
1 canning company	660	Und.	
Decatur			
1 canning company	420	Und.	
1 poultry company	1,700	NP	
Garfield			
1 canning company	1,200	Und.	
Gravette			
1 slaughterhouse	Und.	Und.	
Hiwasse			
1 slaughterhouse	Und.	Und.	
1 canning company	1,000	Und.	
Pea Ridge			
1 canning company	660	Und.	
1 poultry dressing Co.	Und.	Und.	

TABLE L cont'd

Sheet 4 of 4 Sheets

Name and Location	Population Served	Improvements Needed *	Remarks
Vaughn			
1 canning company	600	Und.	
OKLAHOMA			
Municipalities			
Chelsea	1,050	R	
Jay	600	E-A	
Picher	1,200	E-A	Also receives sewage from Cardin. Pop. served 300.
Quapaw	500	E-A	
Vinita	4,300	E-A	
Welch	300	E-A	
N.E. State Hospital (Nr. Vinita)	3,000	E-A	
Industries			
Pryor			
2 paper mills	1,000	Und.	Both have waste treatment
Miami			
1 rubber plant	Und.	NP	
Seneca, Mo.-Okla.			
1 milk processing plant	Und.	R	Plant located on State boundary.
Craig Co.			
Coal mines	Und.	Und.	
Oil Fields	Und.	Und.	

* NP - New plant
E-A - Enlargement or addition to existing plant
R - Replacement
Und. - Undetermined

Note: Specific information not available for the coal, lead and zinc mining and oil production operations; hence the industries are combined into a single category and represented as a single problem.

TABLE 1a
BASIC DATA ON SOURCES OF MUNICIPAL POLLUTION

GRAND (NEOSHO) RIVER BASIN
December 1952

Watercourse -- Municipality	River Mile*	Population Served by Sewers	P.E. (B.O.D.) Untreated Wastes	Waste Treatment Provided	Adequacy of Treatment Facilities		P.E. (B.O.D.) Disch'd to Water-course	Treatment Needs**	Current Status Municipal Action
					Cap'y	Opr.			
GRAND(NEOSHO)RIVER									
White City, Kans.	N473	100	100	Sec.	Sat.	Unsat.	25	None	
Council Grove, Kans.	N448	2,300	2,650	Sec.	Sat.	Sat.	660	None	
Cottonwood R.	N383								
Hillsboro, Kans.	-	1,300	1,300	Sec.	Sat.	Sat.	325	None	
Marion, Kans.	Co124	1,800	1,800	Sec.	Sat.	Sat.	450	None	
Florence, Kans.	-	950	950	Pri.	Unsat.	Unsat.	740	R	Undetermined
Doyle Cr.	Co106								
Peabody, Kans.	-	1,100	1,100	None	-	-	1,100	NP	Undetermined
Cottonwood Falls, Kans.	Co53	750	750	Sec.	Unsat.	Sat.	200	E-A	Undetermined
Emporia, Kans.	Co14	13,000	13,200	Sec.	Unsat.	Sat.	2,000	E-A	Undetermined
Burlington, Kans.	N339	2,000	2,000	Sec.	Unsat.	Sat.	500	E-A	Undetermined
LeRoy, Kans.	N321	500	500	Sec.	Unsat.	Sat.	125	E-A	
Iola, Kans.	N292	5,700	7,700	Sec.	Unsat.	Sat.	1,900	E-A	Undetermined
Humboldt, Kans.	N280	1,900	1,900	Sec.	Sat.	Sat.	480	None	
Owl Cr.	N279								
Yates Center, Kans.	-	1,850	4,050	Sec.	Sat.	Sat.	1,000	None	
Chanute, Kans.	N266	9,000	9,450	None	-	-	9,450	NP	Under construction
Erie, Kans.	N244	1,150	1,750	None	-	-	1,750	NP	Undetermined
St. Paul, Kans.	N233	500	500	Sec.	Sat.	Unsat.	130	None	
Oswego, Kans.	N187	2,200	2,700	Sec.	Unsat.	Unsat.	700	R	Undetermined
Lightning Cr.	N185								
Girard, Kans.	-	1,500	1,650	Sec.	Sat.	Sat.	400	None	
Labette Cr.	N171								
Parsons, Kans.	L33	17,000	23,000	Sec.	Unsat.	Sat.	5,800	E-A	Under construction
Chetopa, Kans.	N170	1,500	1,500	None	-	-	1,500	NP	Undetermined
(Kans.-Okla. Line)	N165								

TABLE 1a (Cont'd)

Watercourse -- Municipality	River Mile*	Population Served by Sewers	P.E. (B.O.D.) Untreated Wastes	Waste Treatment Provided	Adequacy of Treatment Facilities		P.E. (B.O.D.) Disch'd to Watercourse	Treatment Needs**	Current Status Municipal Action
					Cap'y	Opr.			
Miami, Okla.	N144	10,500	10,500	Sec.	Sat.	Sat.	600A	None	
Tar Cr.	N142								
Picher, Okla.	-	(1,200)	(1,200)	Pri.	Unsat.	Unsat.	375	E-A	Plans approved
Cardin, Okla.	-	(300)	(300)						
Commerce, Okla.	-	2,100	2,100	Sec.	Sat.	Sat.	210	None	Completed 1952
Spring R.	130.6								
Marionville, Mo.	-	300	300	Sec.	Sat.	Sat.	30	None	
Aurora, Mo.	-	2,150	2,750	Sec.	Sat.	Unsat.	275	None	Planning minor improvements
Mt. Vernon, Mo.	-	1,600	1,600	Sec.	Sat.	Sat.	265	None	Built 1949; design population 4,000; cost $135,000
State Sanitorium	-	1,050	1,050						
Carthage, Mo.		8,000	8,000	Sec.	Unsat.	Sat.	1,200	E-A	Inactive
North Fork									
Lamar, Mo.	-	1,430	2,130	Sec.	Sat.	Sat.	105	None	
Jasper, Mo.	-	75	75	Pri.	Unsat.	Unsat.	55	R	Active planning
Cow Cr.	S41								
Frontenac, Kans.	-	1,500	1,500	Sec.	Sat.	Sat.	380	None	
Pittsburg, Kans.	-	18,000	20,100	Sec.	Sat.	Sat.	5,000	None	
Spencer Chemical Co. (Nr. Pittsburg, Kans.)		1,000	1,000	Sec.	Sat.	Sat.	150	None	
Mount Carmel Hospital, Kans.		400	400	Sec.	Sat.	Sat.	40	None	
Center Cr.	S36								
Sarcoxie, Mo.	-	400	400	Pri.	Unsat.	Unsat.	280	E-A	Inactive; needs secondary
Carterville, Mo.	-	1,200	1,200	None	-	-	1,200	NP	Inactive
Webb City, Mo.	-	4,500	4,500	None	-	-	4,500	NP	Inactive; needs secondary
Carl Junction, Mo.	-	500	500	None	-	-	500	NP	Inactive

TABLE 1a (Cont'd)

Watercourse -- Municipality	River Mile*	Population Served by Sewers	P.E. (B.O.D.) Untreated Wastes	Waste Treatment Provided	Adequacy of Treatment Facilities		P.E. (B.O.D.) Disch'd to Watercourse	Treatment Needs**	Current Status Municipal Action
					Cap'y	Opr.			
Turkey Cr.	S34								
Joplin (N) Mo.	-	25,200	25,200	Sec.	Sat.	Sat.	2,000	None	Built 1950; design population 45,000; cost $800,000
Galena, Kans.	S29	3,800	3,800	None	-	-	3,800	NP	Undetermined
Shoal Cr.	S26								
Monett, Mo.	-	4,160	6,570	Sec.	Sat.	Sat.	660	None	Built 1949; design population 10,000; cost $130,000
Neosho, Mo.	-	5,000	8,300	Sec.	Sat.	Sat.	1,250	None	Built 1943; design population 24,000
Joplin (S) Mo.	-	5,400	5,400	Sec.	Sat.	Sat.	540	None	Built 1949; design population 10,000; cost $250,000
Brush Cr.	S24								
Columbus, Kans.									
#1	-	1,600	1,600	Sec.	Sat.	Sat.	400	None	
#2	-	1,600	1,600	Sec.	Sat.	Sat.	400	None	
Baxter Springs, Kans.	S20	4,500	4,500	None	-	-	4,500	NP	Undetermined
Quapaw, Okla.	S14	500	500	Pri.	Unsat.	Unsat.	350	E-A	Active planning
Elk R.	N113.6								
Sugar Cr.	-								
Bentonville, Ark.	-	3,000	3,000	Sec.	Sat.	Sat.	500	None	Built 1949; design population 7,200; cost $98,000
Horse Cr.	-								

TABLE 1a (Cont'd)

Watercourse -- Municipality	River Mile*	Population Served by Sewers	P.E. (B.O.D.) Untreated Wastes	Waste Treatment Provided	Adequacy of Treatment Facilities		P.E. (B.O.D.) Disch'd to Watercourse	Treatment Needs**	Current Status Municipal Action
					Cap'y	Opr.			
Afton, Okla.	-	1,050	1,050	Sec.	Sat.	Undet.	105	None	Built 1951; design population 1,250; cost $43,000
(Pensacola Dam)	N77								
Cabin Cr.	N67								
Vinita, Okla.	-	4,300	4,300	Sec.	Unsat.	Sat.	1,300	E-A	Inactive; needs final settling
L. Cabin Cr.	-								
Welch, Okla.	-	300	300	Sec.	Unsat.	Sat.	90	E-A	Inactive; needs final settling
E. Okla. Hospital (Vinita)	-	3,000	3,000	Pri.	Unsat.	Unsat.	2,000	E-A	Inactive; needs final settling
Spavinaw Cr.	N60.6								
Gravette, Ark.	-	650	650	Sec.	Sat.	Sat.	60	None	Built 1950; design population 1,450
Brush Cr.									
Jay, Okla.		600	600	Sec.	Unsat.	Sat.	180	E-A	Inactive; needs final settling
Pryor Cr.	N39.7								
Chelsea, Okla.	-	1,050	1,050	Pri.	Unsat.	Unsat.	900	R	Inactive
Pryor, Okla.	-	4,500	4,500	Sec.	Sat.	Sat.	900	None	Equipment being improved

* River mile above mouth of stream.

** R - Replacement
NP - New plant
E-A - Enlargement or addition to existing plant